PARALYSIS AGITANS

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ON PARALYSIS AGITANS;

WITH AN ACCOUNT OF THE CLINICAL FEATURES OF OTHER

FORMS OF TREMOR.

(*With Ten Illustrations*).

BY

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PREFACE.

The credit of first describing the symptoms of Paralysis Agitans and of recognising the affection as a definite disease of the nervous system, is due to James Parkinson, Member of the Royal College of Surgeons of England. In his admirable "Essay on the Shaking Palsy," published in 1817, he very clearly described the prominent features of the disease. Hence the affection is sometimes spoken of as Parkinson's disease in England: on the continent, more frequently than in England, the discoverer's name is given to it.

His definition of the affection was as follows:—"Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forwards, and to pass from a walking to a running pace, the senses and intellects being uninjured."

Though 84 years have elapsed since this definition was given by Parkinson, it still admirably indicates the chief clinical features of the disease. There are very few diseases on which modern pathology has been able to throw so little light, and the slight advance in our knowledge of the affection since the time of Parkinson ill repays the attention devoted to its study clinically and pathologically. Of the pathology of paralysis agitans it may be truly said that as yet we "see through a glass darkly."

For many years it has been necessary for me to devote considerable attention to the symptomatology and palliative treatment of the disease; and I have ventured to publish the following review of the affection with the hope that it may be of some interest to those who have cases of this distressing ailment under their care. To the description of Paralysis Agitans I have added an account of the clinical features of other forms of tremor.

The account of the symptomatology and the description of the clinical features of the various forms of tremor have already been published in two articles in "The Medical Chronicle."

R. T. W.

April, 1901.

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PARALYSIS AGITANS.

PARALYSIS agitans is a disease chiefly characterised (1) by tremor; (2) by difficulty in movement, owing to muscular "rigidity," to the slow conduction of motor impulse, and to some muscular weakness; (3) by a peculiar attitude and gait; and (4) by certain subjective sensory symptoms.

Onset of the disease.

The disease usually commences gradually: but when it follows fright or mental shock, the onset of one symptom at least—tremor—is often sudden.

In the latter group of cases the tremor often commences directly after the fright. It continues for a few hours or a day or two; then it often subsides for a short time, but returns again and becomes persistent, and the other symptoms gradually develop. (In four cases which will be reported subsequently, I obtained a history of the *sudden* onset of the tremor after a severe mental shock.)

In the majority of cases, however, the onset of the disease is very gradual.

In most cases tremor is the first symptom. The usual course is for tremor to commence in one hand. At first it only occurs occasionally, as when the patient is excited; but in time it becomes constant. Six months or a year later the leg on the same side is affected by the tremor; then the arm, and afterwards the leg on the opposite side are affected. The tremor in the legs is usually slight as compared with that in the arms. The order of involvement of parts just mentioned is not invariably followed; occasionally the tremor begins in the shoulder or upper arm and descends to the hand. In rare cases the tremor has commenced in the leg first and then extended to the arm, affecting the shoulder muscles first and chiefly (as in the case described on pages 24 and 25). But when the disease is fully developed the tremor is most marked in the hands.

Sometimes the patient complains at first of an ill-defined sensation of weakness and stiffness, or of dull aching pain, in the limb which afterwards becomes affected with tremor. Not infrequently such cases are regarded as rheumatic at first.

In some cases rigidity and slight impairment of movement in a limb is the first symptom of the disease.

In the case which is recorded on p. 23, the first symptom was stiffness in one leg, which caused a slight dragging of the limb in walking. In another case (see page 24) before the tremor developed the patient had suffered for three years from pain, stiffness, and weakness in the left hand, which had been subject to over strain. Similar cases are recorded by Krafft-Ebing. Sometimes the first symptom has been aching pain in one limb and, at a later date, tremor has developed in the same limb.

An important feature of the disease is its unilateral nature at first. The tremor, stiffness or other symptoms remain unilateral for some time at first, and then the other side is affected. In the two cases just mentioned the symptoms were unilateral for three and six years respectively.

The cases vary considerably in the time which elapses before the symptoms of the disease become well marked.

SYMPTOMS.

Tremor is a very prominent symptom in paralysis agitans, though cases of the disease are occasionally met with, in which it is absent, at least temporarily.

The tremor consists of regular rhythmical movements. They occur at the rate of 5 to 7 per second; they are usually most marked in the fingers, thumb, and wrist; and the small muscles of the hand and the flexors and extensors of the fingers, thumb, and wrist are the muscles most affected.

The range of movements is not great (in the fingers ⅛—¾ inch—Sir W. Gowers). In many cases the movements are chiefly between the fingers and thumb; they consist of rapid flexion and extension of slight range, and resemble those produced in rolling a pill between the fingers and thumb. The wrist is also slightly flexed and extended along with the movements of the fingers, and there is also a certain amount of alternating slight pronation and supination. Occasionally there is a little lateral movement of the wrist. In many cases the fine movements of the fingers and thumb (pill-rolling movements) are most prominent. In other cases the movements at the wrist, rapid extension and flexion, with a little supination and pronation, are most pronounced; they are of wider range, and coarser than those of the fingers.

The type of movement may vary from time to time. I have seen the tremor to consist chiefly of the wrist movements at an early stage, and then later the finger and thumb movements have developed. Also when the patient is excited and the tremor severe, I have seen the movements of the wrist to be more prominent, and afterwards, when the tremor has been less, the fingers and thumb have been more affected.

The shoulder and upper arm muscles are usually unaffected, or less affected than the hand and forearm muscles.

The feet and legs are usually affected much less than the arms, and the tremor is less constant in the legs. In severe cases I have often noticed that the tremor has been present in the legs, only when the arms have been trembling violently. When the toes are affected with the tremor, they are rapidly, but slightly flexed and extended, and the movement is especially marked in the big toes. As already mentioned, the tremor of paralysis agitans occasionally commences in one leg, and then extends to the arm. In these cases the tremor of the leg—for a time at least—is more marked than that of the arm. Occasionally in such cases only the upper arm muscles are affected, or they are affected much more than the muscles of the hand and forearm (as in the case recorded on pages 24 and 25). The head and face are usually not affected, but this is not invariably the case. I have at present under my care a well marked case of paralysis agitans, presenting all of the typical symptoms of the disease, in which the lower lip and masseters are affected with tremor. The lower lip is in a state of constant rapid movement, up and down, towards and away from the upper lip, which is quite motionless. The movement is produced by the muscles of the chin and lower lip. When the tremor of the lower lip is very severe, the masseters contract also, and there is a rapid, but slight movement of the lower jaw. The other muscles of the face, the tongue, the ocular muscles, and the muscles of the neck are not affected with tremor. [The tremor of the lip ceases when the patient speaks, whistles, attempts to blow out a lighted match, or performs any movement of the lips. It also ceases when the patient opens the mouth.]

The tremor of paralysis agitans continues when the arm is supported; it continues during repose of the limbs; and it is usually most marked in repose. *During* voluntary movements, to which the attention is given, usually the tremor ceases entirely, or greatly diminishes, for a few seconds or longer, and then commences again. When the patient is told to grasp any object held in front of him, usually the hand becomes steady and the object is held steadily for a short time. When the patient is told to hold out the hands in front of him, the tremor usually ceases. This cessation or great diminution of tremor on careful movement or on holding any object in the hand, is a point of great importance in diagnosis, since in disseminated sclerosis and many other forms of tremor, the tremor is increased on voluntary movement.

This feature of the tremor is very striking. Thus a patient may be able to take a teaspoon full of medicine and carefully carry it to the mouth, without spilling any, by the hand which a few seconds previously was in constant tremor. In paralysis agitans the patient is able to feed himself (or herself) quite well, to thread a needle, to do needlework, and to write fairly well, even after the tremor has become marked. At a very advanced stage, of course, these movements become more and more difficult.

When the leg is affected with tremor it usually ceases on performing any movements, such as touching an object with the foot, but after the movement it commences again. As already mentioned, in the rare cases in which the lip or face muscles are affected by tremor, voluntary movements of these parts cause the tremor to cease. In this respect the tremor of the lip and face muscles differs from the tremor occurring in these parts in general paralysis of the insane and other diseases.

[Occasionally the tremor of paralysis agitans is slightly increased by, or occurs only during, voluntary movement, probably owing to excitement. Hence, though the cessation of tremor on voluntary movement is almost diagnostic of paralysis agitans, the persistence or increase of tremor on movement does not enable us to exclude paralysis agitans in the differential diagnosis.]

D. Gerhardt has pointed out that the tremor of paralysis agitans increases just *after the completion* of a voluntary movement, whether it had been arrested or had persisted during the voluntary act. This feature I have often noticed.

The tremor of paralysis agitans may often be checked by the will for a few seconds, or it may be checked by the patient firmly grasping some object, such as the arm of a chair. After this voluntary check its severity is often diminished for a time. By attracting the patient's attention to the hand during examination the tremor may cease for a few seconds. It may also cease when the patient is reading an interesting book. It ceases during sleep and during chloroform narcosis. It is diminished when the patient is in the open air. By a cold climate or by cold weather it is diminished ; it is increased by warm close weather, or by a close warm stuffy room. It diminishes or is arrested by driving in a carriage or by riding in a shaky omnibus, but commences again directly the vehicle comes to a standstill. It is also diminished during a railway journey. When the arms are grasped and held up vertically above the head the tremor is sometimes temporarily arrested. By seizing the patient's index finger and forcibly over-extending it the tremor can often be checked for a short time. This feature, I believe, was first mentioned by Weir Mitchell. Also the tremor is sometimes arrested by placing the hands on the sides just above the iliac crests—fingers in front, thumbs backwards. Mental excitement, worry, anxiety, sorrow, joy, and even the visit of a friend greatly increase the tremor ; freedom from worry and excitement and a quiet life diminish it.

When the patient attempts to draw a straight line on paper the tremor, even when marked, often greatly diminishes or ceases entirely ; and the line may be fairly straight (see Fig. A.) ; but at a very advanced stage the drawing of a straight line on paper becomes more difficult.

The handwriting is for a long time only slightly affected, and even when the tremor and symptoms of the disease are well advanced the patient may be able to write fairly well. [In other forms of tremor of the same degree the handwriting is greatly affected.] The writing is, however, much slower. The letters are well formed in their general outlines, and the separate strokes are fairly correct in direction, but they show fine wavy irregularities. At first these irregularities are scarcely recognised by the naked eye, but can be seen by the aid of a lens. Later, very fine wavy irregularities of the separate strokes are evident to the naked eye, but they are usually much finer than in other forms of tremor. The letters have not the jerky irregularity of disseminated sclerosis, and are better formed than in other varieties of tremor (see Fig. B and Plate I., 1 and 2).

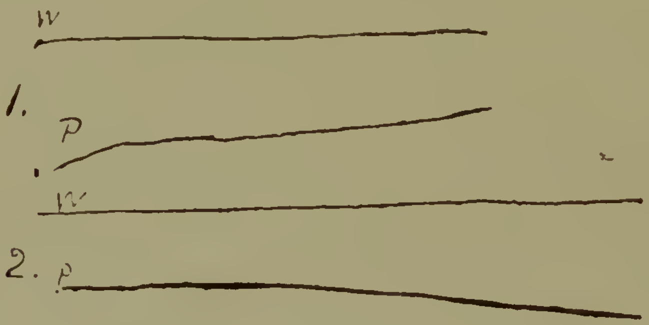

Fig. A. Lines marked W were drawn by the writer; those marked P by two patients suffering from advanced Paralysis Agitans, with violent and constant tremor.

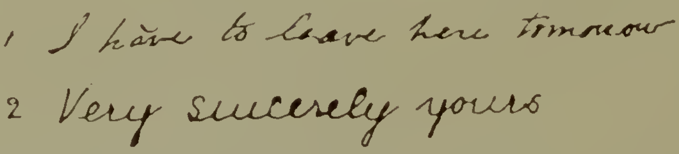

Fig. B. Handwriting of two patients suffering from advanced Paralysis Agitans, with constant tremor.

Altogether the handwriting is usually much better, and a line drawn by the patient on paper much straighter than in other forms of tremor of the same intensity, because the tremor in most cases of paralysis agitans ceases or diminishes on voluntary movement.

The character of the tremor in paralysis agitans usually corresponds to that just described, but rare cases are on record in which it has apparently differed somewhat.

In one typical case, which I have treated for a long period at the Ancoats Hospital, the tremor had the usual characters, being well marked during repose, but ceasing or greatly diminishing during voluntary movement If a large dose of hyoscine were given to this patient the tremor ceased entirely, both during repose and during movement; but if the dose were smaller, the tremor ceased only during repose, whilst slight tremor occurred on voluntary movement. The latter condition was therefore just the opposite of that observed when the patient was taking no drug.

Muscular rigidity or fixation is a symptom of great diagnostic importance, and in those rare cases in which tremor is absent (at least temporarily) muscular "rigidity" is present. It causes difficulty in movement, and leads to the peculiar attitude of the body.

The rigidity or fixation is slight at first and generally unilateral ; later it is bilateral. Descriptions differ as to whether there is rigidity to passive movement of the limbs or not. In cases which I have had the opportunity of following up to an advanced stage of the disease, I have been struck by the difference between the rigidity in paralysis agitans and that in the various forms of spastic paralysis (paraplegia and hemiplegia). In the rigidity of paralysis agitans I have been able to detect that in passive movements there has been stiffness, or resistance, but this has usually been slight, even in advanced cases, in comparison with the rigidity in spastic paraplegia or hemiplegia. Also the great increase of the knee-jerk and ankleclonus are absent in the rigidity of paralysis agitans. Hence I think the term fixation is perhaps better than rigidity, in order to distinguish this condition from that of true spastic paralysis.

Attitude. In course of time the body assumes a peculiar fixed posture, the head is bent forward and sinks more and more on the chest. The upper part of the vertebral column is also bent forwards.

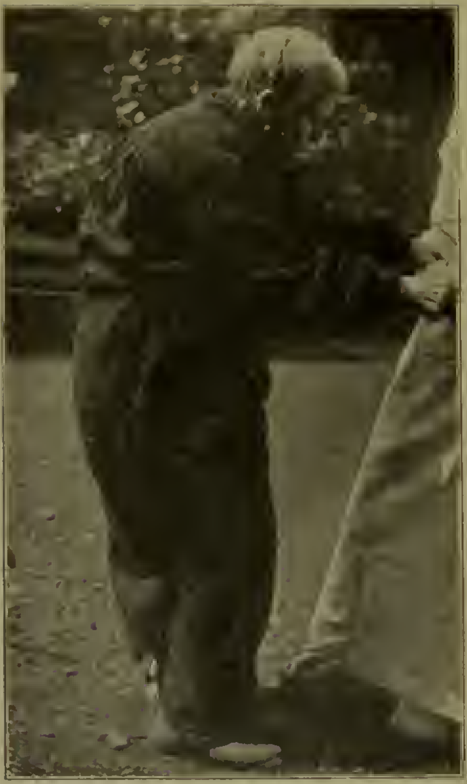

FIG. C. Showing stooping attitude in Paralysis Agitans.

The arms are slightly abducted and are flexed at the elbow (at an obtuse angle).

The legs are bent at the hips and knees slightly and the thighs adducted so that the knees come together. The result of these abnormal fixed positions of the limbs is a stooping attitude well shown in the photograph of one of my patients, fig. C., and in fig. D., which is reproduced from the *Nouvelle Iconographie de la Salpêtriere* 1895, by the kind permission of Dr. Paul Richer, of Paris.

The hand is generally a little extended at the wrist; sometimes it is slightly flexed. (1) The fingers in some cases are slightly bent at all the joints ("rest position."—Sir W. Gowers). (2) In other cases the fingers are flexed at the metacarpophalangeal joints, but extended at the phalangeal joints ("interosseal" position, "writing position" of fingers). The fingers

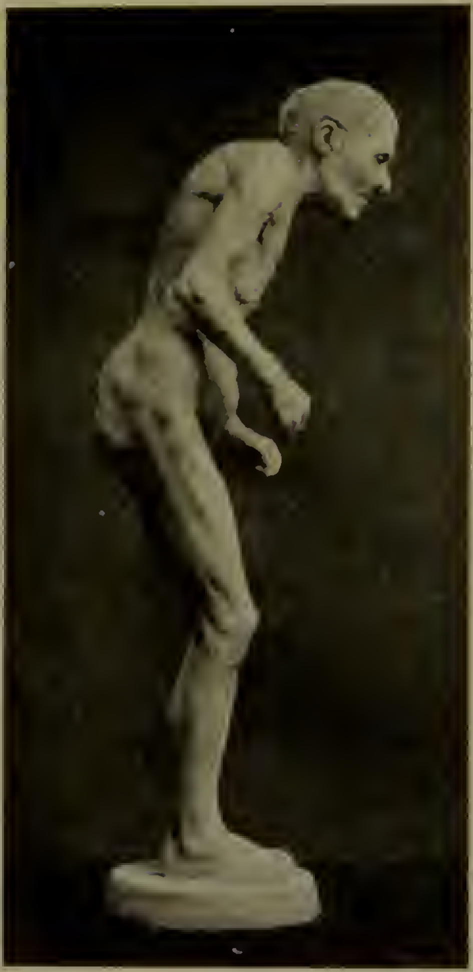

FIG. D. Photograph of model showing attitude in Paralysis Agitans. (Reproduced from article by Dr. Paul Richer and Dr. Meige, *Nouvelle Iconog. de la Salpêtriere*, 1895).

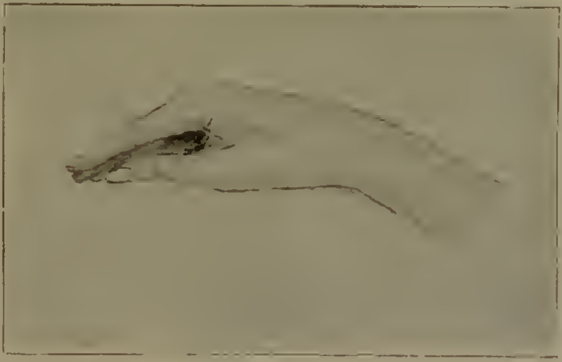

FIG. E. Showing usual "writing" or "interosseal" position of fingers in advanced Paralysis Agitans.

are near to each other, and sometimes the terminal phalanges of the fingers are flexed, more or less, on the second phalanges, and the second phalanges hyper-extended on the proximal phalanges, as in rheumatoid arthritis. Also the fingers sometimes deviate towards the ulnar side of the hand. Occasionally there is extension of the terminal phalanx on the second, flexion of the second on the proximal, extension of the proximal on the metacarpal bones, and flexion of the carpus on the forearm with deviation to the ulnar side (Siotis).

The thumb is often bent backwards (over extended) at the last phalangeal joint, and the soft parts over the terminal phalanx of the thumb (on the palmar side) are markedly flattened, so that the thumb appears shortened at its terminal part (Siotis). This condition is well marked in two cases of paralysis agitans now under my care. Fig. F. represents a tracing of the thumb on paper in one of the cases.

Occasionally the interossei become permanently contracted and shortened, and then it is no longer possible by passive movement to extend the fingers at the metacarpo-phalangeal joints beyond a right angle (Sir W. Gowers).

The *feet* in some cases present no change. In advanced cases they sometimes assume the position of talipes equino-varus, or they are markedly inverted. I have seen the toes, with the exception of the great toes, flexed at all their joints, so as to appear curled down towards the soles of the feet. The big toes were in their normal position.

Purves Stewart has drawn attention to another affection of the toes which may be one of the earliest symptoms of the disease. "The patient complains, when walking, that the toes of one foot occasionally becomes spontaneously strongly flexed and curled up under the sole in a cramp-like position, causing difficulty in walking." For a minute or two all the toes are affected, except the big toe, which is usually hyper-extended. In some cases the foot becomes inverted as well.

Types of Attitude. Four types of attitude have been described by Bidon (Wollenberg). (1) The simple flexor type (the one already described), which is by far the most common variety. The three other forms are very rare. (2) Extensor type. (3) Extensor type, with the head bent backwards. (4) Extension of the trunk and limbs with flexion of the head and neck.

The *face* has a fixed expression ; it is usually grave, sorrowful or anxious. The expression is little varied by emotions. The naso-labial folds are frequently deep and the angles of the mouth are often drawn down a little. The forehead is frequently wrinkled transversely when the disease is advanced.

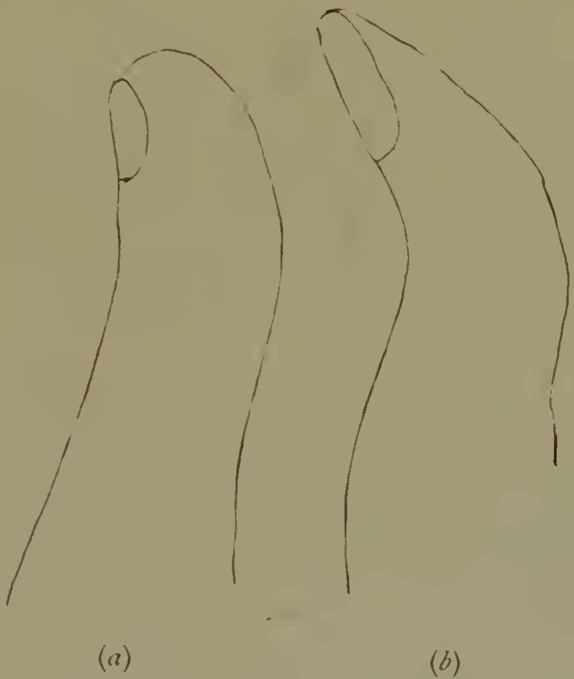

Fig. F. Tracings of thumbs :—(*a*) normal ; (*b*) from case of Paralysis Agitans, showing flattening of tissues over palmar surface of terminal phalanx, and bending backwards of this phalanx.

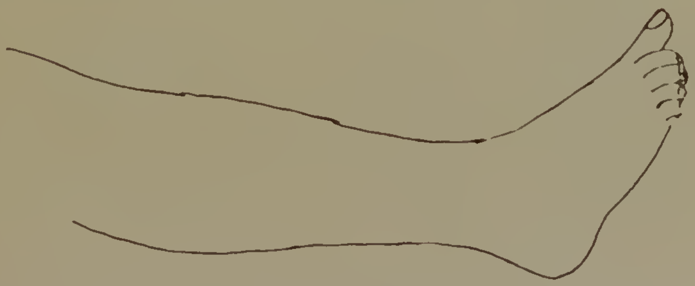

Fig. G. Foot in a case of Paralysis Agitans, showing marked flexion of the toes, except the big toe, at all the joints.

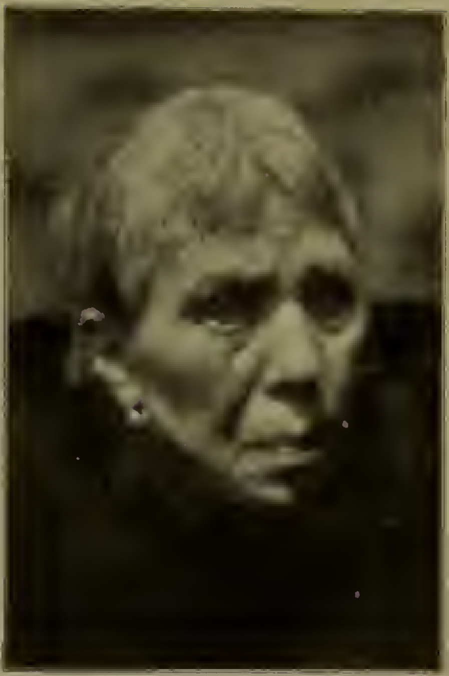

FIG. H. Face in Paralysis Agitans.

Moczutkowsky's sign is often present. When the patient is told to wrinkle the forehead and to keep it wrinkled for one or two minutes, the folds persist for 40 or 60 seconds after the patient has ceased to make the muscular contraction.

I have found that this symptom can be best demonstrated by making the patient look upwards *as high as possible* for a minute. The forehead becomes markedly wrinkled by this movement. The patient is then told to look downwards suddenly. In a healthy person the wrinkles of the forehead produced by looking upwards at once disappear on looking down; but in paralysis agitans they persist for a short time owing to the muscular rigidity.

Often the patient suffers from attacks of flushing of the face.

In an advanced stage, when the patient wishes to look to one side, the eyes move at once laterally, but the head and neck are moved laterally very slowly or very slightly.

The *gait* in course of time gradually becomes more and more difficult, until the patient is unable to walk alone, and then finally the greatest assistance is necessary. In walking there is a tendency to bend forwards ; the patient's steps at first are slow and difficult, then there is a tendency to take quicker steps (festination), and the patient requires assistance to prevent him from falling forwards (propulsion). The condition has been described as if the patient were running after his centre of gravity. If the patient be pushed backwards slightly there is often a tendency to run backwards (retropulsion).

The muscular movements are performed slowly, and there appears to be a slow conduction of voluntary impulses to the muscles. Some time elapses at the commencement of a movement before the muscles obey the will. Owing to the muscular fixation or rigidity the patient moves "all of a piece" in the late stages of the disease. Muscular power as shown by the grasp of the hand, or by the dynamometer, is often only very little diminished. The weakness increases at a later stage, but absolute paralysis never occurs.

The voice is often affected, it is of one tone and without modulation. Often it is weak and tremulous. On commencing to speak, often there is a little difficulty; an effort is necessary before the patient is able to speak; at first the speech is slow and dragging, then hasty.

The knee-jerks are usually normal, sometimes a little increased. Ankleclonus is absent. This is certainly the usual condition, but several writers mention that in rare cases ankleclonus has been observed. Ankleclonus has been absent in all the cases which I have examined. The plantar reflexes are usually present and of the flexor type. The other skin reflexes are normal. The Westphal paradoxical contraction is sometimes present. [I have observed it in the anterior tibial muscles.] Wasting of the muscles only occurs at a very late stage of the disease. I have seen it well marked in the interossei and thenar and hypothenar muscles in such cases. The electrical reactions are normal or slightly diminished. The bladder and rectum are not affected. The optic discs are normal. I have seen a little œdema of the feet in old standing cases.

Thickening of the skin, diffused or localised, has been recorded by Fränkel and by Reuling. These authors think that the facial immobility and Moczutkowsky's symptoms are in part due to the thickening of the skin. Occasionally it is impossible to crease or fold the skin.

Sensory Troubles. Sensation (to tactile impressions, pain and temperature) is normal on objective examination. This is the statement of most writers. I have examined carefully for objective sensory changes, but have never been able to detect any. Palmieri and Arnaud, however, have recorded a diminution of pain sensibility, sometimes diffuse, at other times in patches. The change is most distinct in the periphery of the limbs: sometimes it is very marked in the part affected by tremor. Karplus has recorded hyperalgesia and hyperæsthesia. Subjective sensory disturbances, however, are common, though the disease is generally regarded as one affecting only the motor part of the nervous system. Frequently the subjective sensory symptoms form the most troublesome feature of the disease, and cause the most distress to the patient. The chief sensory disturbances are (i.) a constant restlessness of the muscles or feeling of uneasiness; (ii.) a disagreeable sensation of heat; (iii.) a feeling of tiredness and aching; (iv.) aching pain of a neuralgic or rheumatoid character.

(i.) The muscular restlessness, uneasiness, or discomfort, is a source of the greatest distress to the patient and his friends. There is a disagreeable sensation or cramp-like feeling in the muscles, which causes the patient to wish to change his position frequently—sometimes every few minutes. In spite of the changes in position, he finds it difficult to get into an easy posture. In the advanced period of the disease the patient is unable to make the movement himself, and hence his attendant must move him a little in one direction, a little in another, at frequent intervals. This muscular restlessness is a frequent cause of sleeplessness at night.

(ii.) Another very troublesome sensory symptom is a disagreeable feeling of heat, referred to the interior of body or to the limbs. This causes the patient to sit far from the fire, to prefer the windows open, even in cold weather, to prefer to have light clothing, and as little covering in bed as possible. A warm stuffy room, warm weather, and a warm climate, cause great discomfort; whilst the patient is most comfortable in a cold room, in cold weather, or in a cold climate, and feels best when out in the open air. The sensation of warmth may occur in paroxysms, and may be accompanied by profuse sweating. I have observed attacks of a sensation of heat, accompanied with redness (flushing) and sweating of the face. The central temperature is normal, but Grasset and Apolinario have detected a slight peripheral elevation of the temperature in the limbs.

I have often noticed, that when this sensation of heat has been very troublesome, the face has been flushed, the tremor very violent and the general restlessness very distressing. But when the patient has obtained relief by the use of hyoscine, I have often observed that the face has lost its flushed appearance, and has become pale, the tremor has greatly diminished or ceased, and at the same time the sensation of heat and general restlessness have greatly diminished or disappeared.

These subjective heat sensations are absent in many cases. In some cases a sense of coldness is complained of.

(iii.) An uncomfortable tired aching sensation is often complained of in the limbs, especially in the arms, and this may be associated, from time to time, with (iv.) pains of a rheumatic or neuralgic character in the muscles of the limbs or neck. I have known severe pains in the limbs to occur, especially at night, when the patient has been warm in bed.

Mental symptoms are usually absent, with the exception of mental depression associated with the discomfort produced by the disease. The intellect is usually clear; but occasionally symptoms of gradual mental failure appear.

Sleeplessness is a symptom which often causes great distress. The muscular restlessness and discomfort may prevent the patient falling asleep on going to bed. More frequently the patient falls asleep soon after going to bed, but awakes very early in the morning about 4 o'clock and cannot fall asleep again. Probably it is the fixed position and the inability to change this position during sleep that awakens the patient, when the body is in an awkward posture. When the patient awakes and is unable to turn over, the tremor becomes violent and he remains awake in a condition of great distress until the usual time for getting up.

The urine has been examined carefully, and from time to time various changes have been recorded, but later observations have been attended with negative results. Tachycardia has been recorded in a few cases.

Course and Termination. The disease runs a chronic course. Often the symptoms are slight and unilateral for several years (see cases mentioned on pages 23 and 24). The disease is steadily progressive, though there are periods during which there is little change in the symptoms.

The duration may be from a few years up to 10 years; and cases are recorded in which the duration has been 20 years or more· Usually death is due, not to the disease itself, but to complications, intercurrent disease, exhaustion and wasting, or to accident. In one case which came under my observation death occurred at the end of seven years from an "apoplectiform attack," probably due to an accidental cerebral hæmorrhage, and this is not infrequently the cause of death. Often death has followed some accidental injury, owing to the patient attempting to get about without assistance. In one case recorded by Strümpell the patient fell into a shallow pool of water, and, being unable to get up, was drowned.

An accidental attack of cerebral hæmorrhage causing hemiplegia arrests the tremor on the affected side, but usually, if the paralysis disappears, the tremor returns. Cases are recorded by Campbell and also by Grashey, in which an attack of hemiplegia was followed by arrest of tremor on both sides, and the tremor did not return when the hemiplegia disappeared.

The *prognosis* is unfavourable. The disease is steadily progressive and probably recovery never occurs; though sometimes there are periods of slight temporary improvement, and for a time the symptoms may cease to progress.

DIAGNOSIS.

When the characteristic symptoms are well developed the diagnosis of paralysis agitans is easy; but at the early stage it is sometimes very difficult.

I. *Diagnosis, when the symptoms are well advanced, from other Diseases Producing Tremor.*—Paralysis agitans may be distinguished by the peculiar attitude, gait, facial expression, fixation of muscles, &c , when these symptoms have developed, since in other diseases giving rise to tremor they are absent. Also in other forms of tremor, frequently there are symptoms which are not present in paralysis agitans, and which indicate the nature of the disease (as in disseminated sclerosis, alcoholism, Graves' disease, &c.).

[The peculiarities and differential diagnosis of other forms of tremor are considered on pages 49 to 68.]

II. *Diagnosis at an early stage of the disease, or when the symptoms develop in an unusual manner.* These are the cases which present the chief difficulties as regards diagnosis.

(*a*) In a few very rare cases of paralysis agitans tremor is absent, at least for a time, whilst the other symptoms (attitude, gait, rigidity, &c.) are present. If only the fact be borne in mind, that tremor is occasionally (though rarely) absent in paralysis agitans, the diagnosis in such cases is not difficult.

(*b*) At the early stages tremor may be absent or very slight for a long period, and the chief symptoms may be stiffness, or a sense of weakness in one limb, or "rheumatic" pain in one limb. In these cases, at first a correct diagnosis is impossible, and it is only by carefully watching for the development of other symptoms that the true nature of the affection can be recognised.

Thus in a case which I saw six years ago, the first symptom was a slight dragging or halting of the left leg in walking, which gave the appearance of a slight limp. There was also slight aching pain in the leg. The knee-jerks were only a little increased and there was no ankleclonus. No definite loss of power could be detected and all the movements could be performed. There was no tremor in the hands or legs at that time. There was no "dropped" foot and no real spastic paresis of the left leg. In walking the left leg was not thrown forwards so easily as the right, but it was somewhat difficult to say why. The toe of the left boot was worn a little more than the right, but the difference was very slight. The dragging or halting of the left leg slowly increased, and slight tremor was noted occasionally in the left leg about 12 months later, and in the left hand about 18 months after the dragging of the left leg was first noted. The tremor of the left hand slowly increased, and about two years after the dragging of the left leg was noted, the symptoms were sufficiently characteristic to enable a diagnosis of paralysis agitans to be made. The right side did not become affected until the end of three years (from the commencement of the dragging of the leg). The right hand then began to tremble like the left, and all the other symptoms of the disease gradually appeared.

In another case the first symptom was pain in the left hand followed by stiffness and slight weakness. These symptoms increased steadily for three years, and then tremor developed in the left hand and presented the typical characters of that of paralysis agitans. The symptoms were left-sided for six years, then the right side was affected.

In a case recently under my care at the Ancoats Hospital, the patient, a woman aged 53, had first noticed tremor in the right foot. This had gradually extended, and 18 months later the right arm had become affected. When I saw the case, at the end of two years, there was well-marked tremor in the right leg and arm; but the left side was not affected. The tremor continued during repose, and was more marked in the leg than in the arm; the toes, especially the big toe, were markedly affected. The big toe was constantly flexed and extended. In the arm the tremulous movements occurred chiefly at the elbow and shoulder, and were due mainly to the action of the deltoid, biceps and triceps. The wrist, fingers, and thumb were not affected, except that the whole hand was moved by the tremor transmitted to the forearm at the elbow. There was none of the "pill-rolling" movements of the fingers, and no flexion and extension movements at the wrists. The fact that the tremor was most marked in the foot, and that in the arm it affected only the upper arm and shoulder muscles, was quite contrary to its usual distribution in paralysis agitans. But the diagnosis of paralysis agitans was indicated by the persistence of the tremor during repose, its unvarying nature, the age of the patient, the absence of indications of any other cause for the tremor, and especially by the fact, that both in the leg and the arm the tremor ceased or greatly diminished on voluntary movement. The facial expression was fixed and little changed by emotions. The patient was frequently troubled with a sensation of heat, and perspired freely very often. These two symptoms had only appeared after the onset of the tremor. She was also troubled greatly by a constant sense of uneasiness or discomfort, which made it necessary to change her position in bed very frequently, and she slept badly at night owing to this restlessness. No indication of other nervous symptoms could be detected.

Another point of importance in the diagnosis of paralysis agitans is the fact that the tremor and rigidity are often unilateral for months or years. In the cases just mentioned the symptoms were unilateral for three, six, and two years respectively. Occasionally a wrong diagnosis is made because this fact is not borne in mind.

When tremor is the only symptom of paralysis agitans which has developed, then its characters are often, but not always, sufficient to distinguish the case from other forms of tremor. A tremor which commences in one hand, between the ages of 40 and 60, which produces "pill-rolling" movements of the fingers or extension and flexion movements at the wrist, which continues during repose of the limb and which is arrested during careful voluntary movements, is almost certainly due to paralysis agitans, providing indications of a gross cerebral lesion are absent. The ability to draw on paper a straight line which shows very little irregularity, and the very slight affection of the handwriting, even when the tremor is marked, are two points also in favour of the diagnosis of paralysis agitans. If the tremor has not the typical characters just mentioned, then it will be necessary to wait for the development of other symptoms of the disease before giving a diagnosis.

ETIOLOGY.

Paralysis Agitans is a very rare disease. At the Manchester Royal Infirmary, in the ten years during which the writer held the post of Medical Registrar, there were 13,929 medical in-patients; of these 2,430 suffered from diseases of the nervous system, but only six from paralysis agitans. Thus the proportion was 1 in 2,321 amongst *medical in-patients*, or 1 in 405 cases of diseases of the nervous system.

The number of deaths from paralysis agitans in England and Wales, as shown by the report of the Registrar-General, was 341 in 1898, or 11 per million living. There has been a slight increase in the mortality in recent years.

The disease is a little more common in males than females, but the difference is not great (60 men, 40 women, Krafft-Ebing; six males to five females in report of Registrar-General for England and Wales).

Paralysis agitans is a disease which usually occurs only in later periods of life.

At the onset of the disease the age of the patient is usually from 50 to 65. Not infrequently the disease begins between 40 and 50, but seldom after 65. It very rarely commences before 40, though exceptional cases are on record (Berger 17 and 25, Buzzard 21, Sir Wm. Gowers 29).

The combined statistics, from the records published by Heimann, Berger, and Peterson of the ages of their patients, give the following results :—

	Heimann.	Berger.	Peterson.	Total.
10—20	—	1 (aged 17)	—	1
20—30	—	1	—	1
30—40	2	1	3	6
40—50	7	12	9	28
50—60	6	12	23	41
60—70	3	10	10	23
Over 70	1	—	2	3
				103

The following table shows the age at death and the sex in paralysis agitans in England and Wales during the year 1898 (prepared from the report of the Registrar-General) :—

	10—	35—	45—	55—	65—	75—	85 and upwards.	Total.
Males	1*	3	6	38	83	52	4	187
Females	—	—	7	28	74	43	2	154
	1	3	13	66	157	95	6	341

*This diagnosis can hardly be accepted in the absence of any account of the case.

Social position does not appear to have much influence. According to v. Krafft-Ebing, Jews are much more liable to suffer from the disease than Christians. A family history of the disease is rare, but Sir William Gowers states that "some inherited influence can be traced in not more than a sixth of the cases, by the occurrence of the same disease, or of more simple forms of tremor in other members of the family." Erb mentions three sisters who suffered from the disease. Other rare instances of heredity are on record.

The antecedent of the disease to which most importance can be attached is mental emotion—either sudden mental shock or prolonged mental emotions.

The following are instances that have come under my own observation in which fright or anxiety appears to have been an important factor in the etiology :—

One of my patients, a woman, aged 61, gave me the following history. She had enjoyed good health until two years previously, when she had a severe fright. One evening, about 11 o'clock, whilst she was quite alone, she thought she heard a knock at the door of her house. On getting up to go to the door she thought she could see an exceedingly tall man in the house. She was so frightened that she fainted, and became unconscious. In a few minutes she recovered consciousness, but she was covered with cold perspiration, and sat by the fire in a state of great anxiety for half-an-hour, until her daughter and son returned home. She trembled very much that evening. For several days she was very nervous. She has never been the same since the fright. A month later the tremor had become very well marked : all the typical symptoms developed afterwards.

Wm. L., aged 46, gave the following history. [This patient was under the care of Dr. Steell at the Manchester Royal Infirmary, where I had the opportunity of observing him when Medical Registrar : to the kindness of Dr. Steell I am indebted for permission to record the case.] Whilst he was engaged in his work in a cotton mill, a fellow workman was killed by becoming entangled in rotating machinery. He saw the accident take place, and assisted in disentangling the man. Immediately he began to tremble violently in the limbs and trunk. He states that the mental shock was very great, and that the tremor continued more or less for two days; then it disappeared, but three months later the tremor returned. At first it affected the left leg only; but in six months it passed to the left hand. The tremor gradually increased, and typical symptoms of paralysis agitans developed.

In another case the patient was greatly frightened during a quarrel. The tremor commenced directly afterwards, and continued all day; it then subsided, but soon returned and persisted. The disease was attributed to the fright, but the patient had suffered also from much anxiety and mental worry.

My friend Dr. Gardner, of Burnley, has informed me of one of his cases, in which a woman was suddenly greatly frightened by hearing that a cotton mill in which she was interested had been burnt down. Soon afterwards one hand began to tremble, and in course of time all the symptoms of paralysis agitans developed. The disease terminated fatally, through intercurrent lung mischief.

Many cases are on record in medical literature in which the disease has followed severe fright or mental anxiety.

Prof. Erb records the following:—A man was standing on the branch of a tree, when the branch broke, and he was in danger of falling from the tree into a brook which flowed underneath. He was terribly frightened, but succeeded in catching hold of another branch and slid down to the ground without any injury. He had become dizzy from the fright and trembled all over the body, so that he could not continue his work. He went home, but the tremor continued in the right arm, and since then has not ceased. At first it was feeble, and did not prevent him doing his work, but in the course of a year and three months it increased gradually and extended to the right leg, and the other symptoms of the disease developed.

Peterson records several interesting cases. One patient was an illicit distiller of whisky, and the disease appeared soon after his discovery and trial and the confiscation of all his property. In three cases domestic infelicity was an etiological factor. One woman developed it during an anxious period of nursing a dying mother, and another during a period of worry over her drunken son. One woman gave sudden fright as a cause. In one man the tremor appeared soon after great excitement incident to a religious discussion.

Mohn records the case of a man aged 50, whose previous health had been good. The patient had suffered from a severe mental shock through seeing his child run over. In the same moment he was attacked with exceedingly severe tremor all over the body, which continued for several hours. The tremor gradually diminished and became localised to the arms. It continued in one arm, but varied in intensity from time to time. Later the tremor increased and all the symptoms of paralysis agitans developed.

A similar case is reported by Hillairet.

Berger mentions the case of a girl, aged 17, in whom the disease developed after a fright. A man was run over and killed before her eyes, tremor commenced in the right hand on the spot; gradually the tremor extended over the right arm, and later the legs were affected: all the signs of paralysis agitans developed.

Hunt reports the case of a female aged 73, in which the tremor appeared soon after a severe nervous strain caused by the anxiety of nursing a sick relative.

Sir Wm. Gowers records the following cases:—A man was wakened by a bell on account of a fire; for a year and a half the same bell always caused transient tremor, which then became permanent, and passed into the typical form of paralysis agitans. A woman aged 37 was sitting quietly at work when a stream of water suddenly flowed from a tap on to her left wrist, she was much startled, the left arm immediately began to shake, and the tremor persisted, passing to the leg and afterwards to the limbs on the opposite side. A year later she presented all the characters of the disease in its typical form.

Charcot records the following case:—The patient's husband was one of the *Garde Municipale* and fought against the insurgents in 1832. Having seen her husband's horse return riderless to the barracks she received a great shock, dreading some disaster. That very day she began to tremble, and the shaking, which at first was localised to the right hand, extending gradually, invaded each of the other members in succession.

Heimann states that excitement, trouble, and sorrow are frequently regarded as the cause. In three out of 19 cases which he records the symptoms followed depressing mental emotions: in one, the disease followed great anger.

Collins and Muskin mentions seven cases in which the disease was attributed to mental shock, anxiety, or worry of various kinds.

Sir Wm. Gowers states that a history of prolonged mental emotion is obtained in about half of the cases.

Ordenstein obtained a history of mental shock or anxiety in one-fourth of his cases.

An analysis which I have made, of the history of 112 unselected cases of paralysis agitans (collected from medical literature) shows that in seven cases the tremor first appeared after a severe fright, and other symptoms of the disease developed later. In 12 cases the symptoms followed mental anxiety, grief, and worry. Thus in 19 out of 112 cases there was a well marked history of mental shock or anxiety. Amongst 100 cases, Krafft-Ebing found that the disease followed psychical trauma in 22.

Sir Wm. Gowers points out that sudden alarm may cause general tremor, so that the verb "to tremble" is in process of conversion into a synonym with "to fear." "Usually the tremor subsides when the alarm is over, but it has been known to persist and develop into this disease, or the tremor may commence a day or two after the shock."

It is probable when paralysis agitans develops after a severe fright that the latter has sometimes only acted as the last factor, the exciting cause, or the accelerating factor in the causation of the disease, and that some pathological changes have been already present in the nervous system. Of the many persons who suffered from severe mental shock, fright, anxiety, &c., only very few develop paralysis agitans. Hence it is probably that there is some predisposing cause or additional factor in the production of the disease. Further, in many cases, no definite history of fright can be obtained.

The cases on record are sufficient to show, however, that fright and mental anxiety (psychical trauma) are important antecedents or etiologial factors in the causation of the disease *in many cases.* They are the most important causes at present known to us.

Mechanical trauma is occasionally the exciting cause of the disease. Often there has been great mental shock in addition to the injury. Krafft-Ebing records seven cases of traumatic origin amongst 110 cases of paralysis agitans. Walz has analysed a number of cases recorded in medical literature. The nature of the injury was as follows: General concussion in six cases, wounds in seven, burns in one, frost-bite in one, sprains, dislocations, and fractures in four, contusions and injuries of indefinite nature in eight. In eight of the cases analysed by Walz the tremor commenced immediately after the accident, or within the first day.

As paralysis agitans follows an injury so exceedingly rarely, there must be some predisposition to the disease, or some additional factor besides the injury in its causation. There is, however, distinct evidence that in certain cases mechanical injury has been an exciting cause. In these cases the tremor has commenced in the part injured, and this fact shows that the injury is not simply a coincidence.

Krafft-Ebing has recorded cases in which *local overstrain* appears to have been an important factor in the causation.

In one case the patient was a painter, aged 66, who had worked exceedingly hard, and had held his pallette in the left hand. This had strained and tired him more and more. Tremor developed in the left hand, and soon extended to the arm. The second patient was a man aged 54, a turner, who had been much overworked For 14 or 15 hours daily he had stood on the left foot, and had turned a wheel with the right foot. In the evening he had often felt great tiredness in the left foot. A deep-seated constant pain developed in the left foot, and gradually increased. Two years later the left leg became weak and stiff, and began to tremble. The arms became affected with the tremor afterwards.

Hochwast records the case of a butcher, who sometimes killed as many as 150 geese daily, by bending the head backwards with the left hand. The left hand was frequently very tired, and after some years tremor developed in it.

The following are notes of an interesting case which came under my own observation :

Mrs. A. C. aged 50, had worked for many years in a cotton mill. On account of the development of an ulcer on one leg, she changed the nature of her work and obtained an employment in which she was able to sit whilst doing her work. In her new occupation in another part of the cotton mill, she was obliged to hold a number of cotton threads in the left hand, between the fingers and thumb, for 10 hours daily. One end of each thread was attached to the loom and the other free end rested between the fingers and thumb of the left hand. The left hand was held in one position during her work, but the fingers and thumb were in constant though slight motion. In course of time, she began to suffer from pain in the left hand. The hand then became stiff and weak, and these symptoms gradually increased until—at the end of three years—she was unable to continue her work and was obliged to obtain employment in another department in the mill. In her new occupation, however, there was also constant strain on the left hand. She had to pull and twist cotton fibres very firmly between the fingers and thumb of the left hand all day long. The weakness and stiffness of the left hand increased more and more, and tremor commenced in the left hand. In a short time she was obliged to give up her work entirely on account of the tremor of the left hand. I saw the patient six months later. There was then well marked tremor in the left hand, chiefly between the thumb and fingers. The movements appeared like those which would occur if anything were being twisted or rolled between the thumb and fingers. The tremor continued when the arm was supported, and it had all the characters of the tremor of paralysis agitans. At that time the patient also complained of pains and weakness in the left hand, arm, and leg ; but there was no real paralysis. The patella reflexes were slightly increased : there was no ankleclonus. Mentally she was quite clear. At a later date she dragged the left leg in walking. For six years the symptoms were present on the left side only. In the seventh year tremor commenced on the right side also. Walking became very difficult and propulsion was present. Finally she had three apoplectiform attacks. She died in the third attack (seven years after the onset of the disease). In this case, of course, it is probable that there was some predisposition to the disease, or that there was some additional factor besides the over-strain. But, there-can be little doubt that the prolonged strain of the left hand, played an important part as an exciting cause of the disease.

Gowers mentions the case of a woman who attended the funeral of a neighbour who had been killed in a van lurry accident. She went to the funeral, carrying a heavy child on the left arm; the arm felt very tired afterwards and the feeling of fatigue persisted and gradually changed to one of stiffness, which proved to be the local commencement of paralysis agitans. Sir Wm. Gowers thinks that the muscular exertion, possibly along with mental emotion, may have been the exciting cause.

Paralysis agitans has sometimes followed an acute illness. This history was obtained in 10 out of 100 cases recorded by Krafft-Ebing.

Berger, Fry, and Bryant, have recorded cases in which the symptoms developed at the end of an attack of typhoid fever.

A number of cases are on record in which the disease has been attributed to exposure to wet and cold.

Berger reports a case in which, after exposure to severe cold, the left hand became painful and swollen. After these symptoms disappeared the hand became weak and rheumatic pain developed and extended over the whole arm. A year later tremor commenced in the same arm, and the typical symptoms of paralysis agitans developed.

Peterson found that in eight out of 47 cases exposure to wet and cold was regarded as the exciting cause. In two, tremor followed almost immediately upon the exposure to the cold, and the exertion required to reach home during a blizzard.

There is no evidence that either syphilis or alcoholism has any influence in producing the disease.

In many cases no history of any exciting cause can be obtained (17 per cent. of Krafft-Ebing's cases).

Briefly stated, it appears therefore, that at present, there is evidence of four important etiological factors:—

(1) The disease is one which usually commences in the *latter part of life*—mostly from 40 to 60.

(2) *Psychical trauma* (sudden mental emotions, shock, fright, &c., and prolonged mental emotions as anxiety and worry) in some cases acts as an important exciting cause.

(3) In a few cases *mechanical injury* is an exciting cause.

(4) In a few cases *overstrain* of a limb appears to play an important part in the causation of the disease.

PATHOLOGICAL ANATOMY AND PATHOGENESIS

In paralysis agitans, *post-mortem* examination reveals no *naked eye* changes in the nervous system to which importance can be attached. A few cases are on record, in which unilateral tremor, similar to that of paralysis agitans, has been present during life, but *post-mortem* examination has revealed a gross cerebral lesion (in Leyden's case a sarcoma of the optic thalamus, in the case of Blocq and Marinesco, a tubercular mass in the crus cerebri). In these cases there were other symptoms, which showed that the tremor was not due to a true paralysis agitans, but to a gross cerebral lesion.

In most of the older *post-mortem* records, the results of *microscopical examination* of the nervous system are also stated to be negative, or to reveal no changes to which importance can be attached. During the last 15 years, however, slight pathological changes have been found in the microscopical examination of the spinal cord in a number of carefully-recorded cases. I have collected from medical literature the records of the careful microscopical examination in 24 of these cases. In 21 of the cases there were similar changes in the *spinal cord.* (The cases were reported by Koller, Borgherini, Ketscher, Dana (first case) Redlich, Wollenberg, Sander, Hunt, Sass, Ballet, and Gordinier). Briefly stated, these spinal changes consisted in a diffuse proliferation of the neuroglia connective tissue, usually with thickening of the walls of the small vessels and a peri-vascular sclerosis.

The neuroglia just beneath the pia-mater was often thickened, as well as the neuroglia septá extending into the cord. Often the thickening of the neuroglia was most marked in the lateral and posterior columns. But in none of the cases was there actual sclerosis or degeneration of any tract of nerve fibres. The thickening of the neuroglia was in many cases most marked just around the blood vessels, forming a peri-vascular sclerosis, and from these parts the thickened neuroglia connective tissue extended between the nerve fibres. In most of the cases these changes were only found in the white matter of cord : but in the case of Sander the proliferation of the neuroglia connective tissue extended into the grey matter.

The walls of the blood vessels were thickened, or surrounded by peri-vascular sclerosis; often the vessels were dilated; proliferation of the intima or media was recorded in several cases, and miliary aneurysms were present in two of the cases.

In one case recorded by Dana (second case), there was a moderate proliferation of the neuroglia connective tissue, without any special thickening of the walls of the blood vessels.

In seven of the 24 cases, the nerve cells in the anterior horns of grey matter were pigmented and degenerated. Their processes had diminished or disappeared, and the cells were atrophied. The Nissl's granules were often degenerated, and the nuclei situated at the periphery of the cells. In three other cases the nerve cells were simply pigmented.

Dana attaches great importance to changes in the region of the nerve cells of the anterior horns, and has recorded a "diminution in the richness of the plexus formed by the dendrite processes." He believes that in paralysis agitans "there is early a functional disturbance, and later a degeneration and destruction of the dendrites of the anterior horn cells which interfere with the even flow of motor impulses, and, finally, lead to motor weakness and rigidity."

Sander thinks that the proliferation of the neuroglia connective tissue in the anterior horns of grey matter influences the intimate contact between the final terminations of the motor neurons of the brain and the dendrites of the anterior horn cells. He thinks that the tremor is to be attributed to persistent interruptions of the motor innervation impulses from the brain.

Ballet has described a peculiar fragility of the protoplasm of the nerve cells in the anterior horns, which is seen in the innumerable ruptures of the processes of these cells in the cervical and lumbar regions.

The lesions hitherto described in other parts of the nervous system have been slight. Changes somewhat similar to those already described in the spinal cord, but very much less intense, have been found in the medulla and pons. The changes found in the cerebrum cerebellum, corpora striati and optic thalami have also been very slight, but careful microscopical examination of these parts has been made in very few cases. (A useful summary of the changes found is contained in a recent article by Dr. Gordinier on the pathology of paralysis agitans—see bibliography.) In two of the cases recently examined by the most modern methods, the results were as follows:

In Dana's case the cells of the central (motor) cerebral convolutions presented "a considerable degree of degeneration. They were not much pigmented, but the nuclei were sometimes seen lying at the edge of the cell. There was chromatolysis in the cell body. The cells were not much atrophied, and the processes looked fairly normal. There was not much vascular or neuroglia change."

In Gordinier's case the only lesion found "in the frontal, temporal, parietal, and occipital lobes was a slight increased vascularity, with a moderate increase of the neuroglia elements. In the motor cortex no degeneration of the cortical fibres was found; a general round-cell infiltration existed throughout the grey and white matter. The cortical cells showed changes identical in character, but not as advanced or as extensive as were those found in the cells of the spinal cord. The layers of pyramidal cells showed but few atrophic cells; many of them presented early degenerative changes, such as excentrically placed and swollen nuclei, with degeneration of Nissl bodies, marked pigmentation, and dilated cellular spaces. A few cells were devoid of processes, but in most cases these were retained."

In both of these cases the chief change in the optic thalami was increased vascularity.

Slight changes have been found in the muscles and peripheral nerves in a few cases only: a slight chronic interstitial neuritis and myositis were recorded by v. Sass.

(For other information respecting the slight changes found in various parts of the nervous system, see the article by Gordinier).

* * *

The result of recent careful pathological examinations shows, therefore, that microscopical changes are found in the nervous system in many cases of paralysis agitans. These changes, however, are only slight, and are best marked in the spinal cord. As already mentioned, the changes most frequently found are diffuse proliferation of the neuroglia, thickening of the walls of the small blood vessels, with perivascular sclerosis and pigmentation, or pigmentation and degeneration of the nerve cells in the grey matter of the anterior horns.

Paralysis agitans and senility. It was pointed out some time ago that in old persons, who have never suffered from paralysis agitans, a slight diffuse proliferation of neuroglia and other changes resembling those found in paralysis agitans, are frequently present in the spinal cord. But in paralysis agitans the changes are very much more marked than in senility ; and there is usually the absence of general arterio-sclerosis and the presence of peri-vascular sclerosis in the former condition. Many observers believe that the difference between the changes in the cord in paralysis agitans and in senility is one of degree only, and that paralysis agitans is "a very intense but precocious form of senility of the nervous system." (Gordinier).

This view was put forward by Dubief so long ago as 1881, and since then Borgherini, Koller, Ketscher, Redlich, Sander, Gordinier, and others have expressed the same opinion.

It is not possible to give in detail all the points for and against this view ; it has been much disputed recently, and the importance of the spinal changes has been questioned. Several of the more important facts brought forward by Fürstner, Erb, and Sir Wm. Gowers in favour of another explanation may be here mentioned.

Fürstner points out that paralysis agitans is not specially common in public institutions where there are collected together large numbers of old people.

Against the theory of the spinal origin is also the fact that often the symptoms are hemiplegic or unilateral at first, and may remain hemiplegic for a long period.

Also perivascular changes in the spinal cord, &c., similar in nature to those described by Redlich and others in paralysis agitans, have been found when no symptoms of paralysis agitans have been present during life.

Moreover, Fürstner records a case in which typical symptoms of paralysis agitans were present during life, and yet the most careful examination of sections of the spinal cords (stained by Weigert's and v. Gieson's methods) revealed no thickening of the vessel walls, no increase of neuroglia, and none of the other changes to which so much importance has been attached. The microscopical examination was quite negative. Oppenheim has recorded a similar case with negative results.

Then the apparent importance of fright and trauma in the etiology of certain cases of paralysis agitans appears opposed to the theory of spinal origin.

Fürstner also records the result of the examination of the spinal cord in three old people The age of the first was 73. The spinal cord was normal. In two other old people, aged 74 and 79 respectively, changes like those described in paralysis agitans were found :—endarteritis, periarteritis, increase of the neuroglia, pigmentation of ganglion cells, obliteration of the central canal. Yet during life there were no symptoms of paralysis agitans in these cases.

Dana, in his last paper on the pathology of paralysis agitans, records a case of this disease in which the spinal cord did not present the above-mentioned changes described by Redlich and many others. He disputes the view that paralysis agitans is merely a premature condition of senility, and due to changes similar in nature, but much more extensive than those found in the cord in old age. He believes the disease to be "primarily a parenchymatous nervous disease," and probably due to changes in the dendrites (first functional, later degenerative and destructive) of the nerve cells of the anterior horns. The changes which he found in the nerve cells have been already mentioned.

But the changes in the nerve cells described by Dana (see page 34) have been found in anæmia and other conditions, and, according to Nonne, cannot be regarded as pathognomonic.

Cerebral Origin of the Disease.

Whilst the relation of paralysis agitans to the changes in the spinal neuroglia and blood vessels is therefore still much disputed, there are also reasons for regarding the disease as one of cerebral origin. Sir Wm. Gowers and Professors

Erb and Wollenberg have emphasised a number of points in favour of the cerebral origin of paralysis agitans, of which the following may be here mentioned.

(1) The unilateral (or hemiplegic) nature of the disease for a long period at first—even as long as three or six years.

(2) The temporary arrest of the tremor after an attack of cerebral hæmorrhage. (In two cases a permanent arrest has been recorded.)

(3) The occasional (though very rare) occurrence of a post hemiplegic tremor resembling that of paralysis agitans.

(4) The occasional occurrence of symptoms, somewhat resembling those of a unilateral paralysis agitans, as the result of a localised organic cerebral lesion (such as tumour of the optic thalamus or crus).

(5) The cessation of the tremor during sleep.

(6) The absence of localised muscular atrophy.

Sir Wm. Gowers is inclined to regard paralysis agitans as the result of a "chronic senile change in the nutrition of the terminations of the branching processes of the motor nerve-cells (the dendrons or dendrites) of the cortex." The changes may possibly be "beyond the reach of observation."

Though the very careful microscopical researches of recent years, as well as the various theories advanced, have not yet led to any definite conclusions respecting the causation which can be at present safely accepted, still the work has not been in vain. No doubt, in the future, these somewhat negative results will be of great value, when by the increase of knowledge we are in a better position to form an opinion as to the cause of the disease.

Two regions of the brain appear to the writer to be deserving of more careful examination in the future, viz., the cerebral peduncles and optic thalami, and the blood supply of these parts.

PALLIATIVE TREATMENT.

Unfortunately there is no treatment known which is able to cure the disease, or even to check its steady advance. But by general treatment, and by the use of everal drugs, we are able to alleviate the distressing symptoms—in some cases markedly, in other cases only slightly. At the early stage the symptoms simply cause slight inconvenience; but later the tremor and constant restlessness and desire to change position, are very distressing. Life then is miserable, and the patient craves for the slightest relief.

During the last seven years, it has been necessary for me to pay considerable attention to the palliative treatment of the disease, in a few cases that have been under my care for long periods; and in the following remarks I do not propose to mention all the varied methods of treatment which have been recommended, but shall simply state the palliative means and treatment which I have found of service.

I. *General Treatment.*

The conditions already mentioned which increase the tremor should be carefully avoided. Mental excitement, the visits of many friends, mental worry and anxiety, all markedly increase the tremor. Therefore the patient should lead a quiet life, and should be spared from mental excitement and anxiety as much as possible. Often the tremor diminishes markedly when the patient is reading an interesting book, or (in the case of a female patient) is engaged with sewing, or needlework. Curiously, female patients are able to do needlework even when the symptoms are marked, the tremor diminishing during the handling of the needle: but of course at a very advanced stage, needlework becomes more and more difficult. Sometimes writing a letter gives relief for a time by checking the tremor. I have heard of a patient who obtained relief, when the tremor was very severe, by tearing paper into small pieces.

By a mental effort the patient is often able to check the tremor for a minute or two, or, he can cause it to cease by firmly grasping some adjacent object such as the arm of a chair. After this temporary arrest the tremor often diminishes slightly for a time. Some patients can check the tremor for a short time by placing the hands on the sides just above the iliac crests, the fingers being directed forwards and the thumbs backwards. Also in some cases the tremor can be arrested for a short time if a friend seizes the arms and holds them vertically above the head. Gentle rubbing of the hand, from the fingers to the forearm, sometimes diminishes the tremor a little, and I have known a warm or lukewarm bath to cause a diminution of tremor for some time afterwards. All these means of temporary relief are useful when the tremor is particularly distressing. Wine, alcoholic drinks, strong tea and coffee all increase the tremor. Hence the patient should abstain from alcoholic beverages, or take only very small quantities, and the tea and coffee should be very weak.

The patient's room should be well ventilated and not too warm ; a warm stuffy room increases the tremor and restlessness. In the open air the patient usually feels much better, and the tremor and general restlessness are greatly diminshed. This is a point which does not appear to have attracted much attention, but from my own observations, and from the statements of patients, I believe that one of the best means of relieving the distressing subjective sensations (restlessness, desire to change position, and sensation of heat) is life in the open air. It is of the greatest importance, therefore, that the patient should sit in the open air as much as possible whenever the weather permits. If the patient's house has a garden attached, he should be recommended to sit out in the garden whenever the weather is suitable.

When the patient is very warm, when he is over burdened with warm clothing, or when the weather is very warm and close, the tremor and subjective symptoms are worse ; whilst these symptoms are diminished when the patient is cool, the clothing light, or the weather cool and bracing. Other conditions being the same, the patient feels more comfortable in a cold climate than in a hot climate.

During a railway journey, or during a drive in a carriage or shaky omnibus, the tremor diminishes, or is entirely checked. I have known a drive in an open carriage daily to give great relief. At the earlier periods I have known the tremor to cease entirely whilst the carriage was in motion, but to commence again directly the carriage stopped. At a later period in this case the carriage drive did not cause the tremor to cease, but it still produced a decided diminution, and had a good effect on the subjective symptoms. When the patient is wheeled in a bath-chair the tremor also diminishes a little so long as the chair is moving. Complete rest in bed produces no good effect ; often it increases the subjective symptoms.

At an advanced stage of the disease the patient has great difficulty in walking alone. He is in danger of falling, and if he should fall he is unable to get up again. Often fatal accidents have occurred in this way, and a serious bodily injury has been produced which has caused death ; or the patient has fallen in front of some vehicle and been run over, or into a pool of water and been suffocated. Hence it is very important that the patient should not be allowed to go about alone when walking has become difficult.

Electricity, especially the Faradic bi-polar bath, is of service according to Professor Erb, who mentions a case in which the tremor often almost disappeared after such a bath. I have tried this method, though only for a very short time, without benefit. Most writers who have given a trial to various forms of electricity have found it to be useless. I have tried systematic massage for long periods without any effect. But gentle rubbing upwards—scarcely more than cutaneous rubbing—as recommended by Sir Wm. Gowers, I have found to give a little temporary relief. Gentle passive movements of the limbs are sometimes of slight service.

II.—*Treatment by Drugs.*

I have tried carefully a very large number of drugs which have been recommended by various writers, and very many which have not been recommended. Often I have pushed them until toxic symptoms have appeared, but the majority have not produced the slightest benefit. Amongst the drugs found useless I may mention arsenic, quinine, potassium iodide and bromide, strychnine, Calabar bean, cocaine, cannabis indica, caffein, nitroglycerine, atropine, nitrate of silver, tannate of cannabin, butyl chloral hydrate, piscidia, chloretone, heroin, dionin, supra-renal extract, and many others.

The drugs which I have found of decided value in the palliative treatment of paralysis agitans are hyoscine hydrobromate, duboisine sulphate, and hyoscyamine.

Hyoscine hydrobromate is the drug which I have found to be the most useful. It was recommended some years ago by Professor Erb of Heidelberg, and has been also recommended by many continental physicians; but in some of the best recent accounts of paralysis agitans in English medical literature the use of hyoscine is not mentioned. Moreover, a number of writers have recorded, that they have not found the drug of any service whatsoever. Professor Erb has recommended the drug to be used hypodermically, and thinks its value, when given by mouth, is very much inferior; also by other continental physicians it is recommended chiefly hypodermically. The English patients suffering from paralysis agitans, who have come under my care, have always objected to treatment by any drug given hypodermically day by day; and in such a chronic disease it does appear to be very desirable to give the medicine by mouth, if possible, for many reasons. The puncture of the skin with the hypodermic needle, once or twice daily for months or even years, appears to me very undesirable on account of the risk of septic infection; also female patients usually object to the pain produced by the prick of the needle, and then there is always a greater risk of an overdose of the drug, if the hypodermic injections be left in the hands of the patient's friends. I therefore commenced the treatment of paralysis agitans some years ago with hyoscine given by the mouth. I gave it in the manner and dose recommended, $\frac{1}{200}$—$\frac{1}{150}$ of a grain in a pill, three and afterwards four times a day, for long periods, without any effect. I increased the dose to $\frac{1}{100}$ of a grain in pill form, but I was never able to detect the slightest benefit. Whitla and others have had the same experience. I gave up the drug entirely, and concluded that it was useless.

At a later date, I again gave it a trial and prescribed it in chloroform water, thinking that it would be perhaps absorbed more rapidly in this form, and that possibly, when given in the form of a pill, the absorption might be too slow to produce any marked effects. Whatever may be the reason of the failure of the drug in the first trial, I was pleased to find a slight but distinct effect when given in doses of $\frac{1}{90}$ of a grain in chloroform water. As many writers (including Prof. Erb) have recommended that the drug should only be given in very small doses, it was a long time before I ventured to give it in larger doses than $\frac{1}{96}$ of a grain. But in course of time I increased the dose to $\frac{1}{75}$ of a grain without any bad effects and found that this dose was distinctly more efficacious than $\frac{1}{96}$ of a grain.

One of my patients who suffers from paralysis agitans with all the characteristic symptoms, has taken hyoscine for four years with short intermissions. The dose has only been small, sometimes $\frac{1}{96}$, sometimes $\frac{1}{75}$ of a grain twice a day in ʒii of chloroform water. No bad symptoms have ever been noted. Though the tremor is not arrested by this dose, it is undoubtedly diminished; and the drug also diminishes the general restlessness and constant desire to change position which is such a troublesome symptom of the disease. Whenever the hyoscine has been discontinued for a few days the tremor and restlessness have always been worse, and it has soon been necessary to return to the drug. The action of the hyoscine in this case has always been most powerful when first commenced: after a time its effect has diminished; but if it has been discontinued for a few days, the effect has been well marked when the drug has been commenced again.

In another advanced case I obtained much better results with hyoscine. The patient was in the Ancoats hospital on two occasions for many weeks and could be carefully watched. All the typical symptoms of the disease were present. At first I injected the drug hypodermically in order to get decided results.

At 12-8 noon I injected $\frac{1}{133}$ of a grain of hyoscine hydrobromate hypodermically. The tremor at that time was very marked, and had been so all morning. In a few minutes after the injection it began to diminish; at 12-15 it was much less; at 12-20 the tremor had disappeared; at 12-35 it was also absent, and remained absent until about 3 p.m. Then the tremor re-appeared; but it remained very slight all afternoon. A few days later I repeated the injection and obtained the same results.

After this marked effect I gave the drug in larger doses by mouth—$\frac{1}{64}$ of a grain in 6 drachms of chloroform water, and occasionally as much as $\frac{1}{54}$ or $\frac{1}{48}$ of a grain. (*Such doses, of course,* *should be given with great caution, and only arrived at very gradually.*)

A few extracts from numerous notes on the action of hyoscine in this case will illustrate its value.

July 25.—At 9-40 a.m. $\frac{1}{48}$ of a grain of hyoscine hydrobromate, in one ounce of chloroform water, given by mouth. The tremor at this time was well marked. At 10-30, on again seeing the patient, the tremor had ceased, and had been absent for about twenty minutes. At 11-15, when again seen, the tremor was almost absent. At 12 o'clock it was absent. The pulse was not affected, and there were no toxic symptoms beyond dryness of the throat.

July 26.—Tremor very marked. At 9-30 a.m. $\frac{1}{55}$ of a grain of hyoscine hydrobromate given in chloroform water. When seen again at 11 the tremor had disappeared; at 11-45 tremor was still absent, The nurse states that tremor returned about 3 p.m., but was very slight.

September 19.—Patient seen at 10-30 a.m.; tremor then constant and violent. Given $\frac{1}{84}$ of a grain of hyoscine hydrobromate in 6 drachms of chloroform water. At 11-30 tremor had practically disappeared, only at long intervals was there a slight tremulous movement of the hand.

September 25.—Seen at 10 a.m.; tremor well marked. Given $\frac{1}{81}$ of a grain of hyoscine hydrobromate at 10-10 a.m. I remained in the hospital ward until 12 o'clock, and was able to watch the hands from time to time, without attracting the patient's attention. By 10-40 the tremor had ceased, and from this time until I left the ward at 12 o'clock there was no tremor, except on a few occasions when the patient was excited by being spoken to by the nurse, or by being moved in bed. At these times a slight tremor would occur in the hands for a few seconds.

In this case the hyoscine not only arrested the tremor, but it checked the troublesome restlessness and desire to change position: also it caused the unpleasant sensation of heat and the flushing of the face to disappear. When the tremor was most marked there was usually great restlessness and flushing of the face, and a sensation of heat. All these symptoms were diminished or arrested by the hyoscine. The dose required to produce this decided effect was $\frac{1}{84}$ of a grain, but this quantity often produced dryness of the throat, which had to be relieved by a little lemon and water. A smaller dose, $\frac{1}{77}$ of a grain, diminished the tremor and restlessness, &c., very much, but did not cause these symptoms to disappear entirely: this dose, however, did not cause any dryness of the throat.

Caution with respect to dose and mode of administration. Hyoscine is a very powerful drug, and it is important to be very *cautious* with respect to the dose and mode of administration. For the reasons already mentioned, I think it is best to give the drug by mouth in paralysis agitans. *At first* the dose should *not* be more than $\frac{1}{150}$ of a grain. This may be increased up to $\frac{1}{100}$ of a grain. If no toxic symptoms appear, such as marked dryness of the throat and dilated pupils, the dose may be cautiously increased. Some patients cannot take $\frac{1}{100}$ of a grain without toxic symptoms appearing; but in paralysis agitans I have found that the dose may often be increased up to $\frac{1}{75}$, $\frac{1}{55}$, or even $\frac{1}{48}$ of a grain without bad effects, except dryness of the throat. But such large doses should only be given when the patient is in hospital, or can be very carefully and frequently watched. In the case just recorded I found $\frac{1}{64}$ of a grain by mouth checked the tremor completely; but frequently it was necessary to diminish the dose to $\frac{1}{77}$ of a grain for a day or two, on account of the dryness of the throat produced by the former dose. The doses which were most useful in this case were therefore $\frac{1}{77}$ or $\frac{1}{64}$ of a grain. *But the exact dose ought to be determined for each case.* I have always used Merck's hyoscine hydrobromate, obtained directly from Darmstadt, and believe that it is the best. *It is important to always use the same preparation* of hyoscine, as probably the strengths of different preparations vary somewhat. I believe it is best to give the hyoscine well diluted in chloroform water. A prescription which is useful is $\frac{1}{8}$ of a grain of hyoscine hydrobromate in six ounces of chloroform water. At first two teaspoonfuls of this may be given, then three, four, or five teaspoonfuls. If necessary, the dose may be increased to six teaspoonfuls ($\frac{1}{64}$ of a grain), providing toxic symptoms are not produced. The hyoscine is best given in the morning, just after breakfast, and again in the evening (just before going to bed, if the patient is troubled with restlessness and sleeplessness during the night).

Duboisin Sulphate was strongly recommended, hypodermically, by Professor Mendel a few years ago. I have given it a fair trial by mouth in two cases. In one case it had little effect; but in the other case it decidedly diminished the tremor and restlessness, when given by mouth in doses of $\frac{1}{64}$ of a grain in water. I have tried it in various doses up to $\frac{1}{48}$ of a grain. Its action is similar to hyoscine, but I have not found it so useful as the latter drug. Usually I have not been able to give more than $\frac{1}{64}$ of a grain without producing toxic symptoms. From records in literature it appears that in some cases hyoscine is most useful, in others duboisin; so that both drugs are deserving of trial in every case.

Hyoscyamine sulphate I have tried, beginning with a dose of $\frac{1}{96}$ of a grain and increasing gradually up to $\frac{1}{55}$. It did not appear to produce dryness of the throat so readily as hyoscine. It diminished the tremor and restlessness, but not so decidedly as hyoscine.

Morphia, opium, and codeia have been found of service by many writers; but in the cases in which I have tried these drugs, if the dose has been small no effect has been produced; if medium or fairly large doses have been given, I have observed the usual bad effects of these drugs (constipation, digestive troubles, &c.) without noticing any relief of the symptoms; and I have not been able to further increase the dose on account of the patient's objections to the bad effects.

In very advanced cases Heimann, Oppenheim and others speak favourably of the use of morphia hypodermically for relieving the tremor and subjective symptoms.

Small doses of tincture of veratrum viride have been recommended in Germany; and Oppenheim recommends also tincture of gelsemium. I have given both a short trial in small doses, but have not observed any good result.

Sleeplessness is often a troublesome symptom in paralysis agitans at an advanced stage. When the patient has a sleepless night, next day the tremor and subjective symptoms are much worse. Hence it is very important to secure a good night's rest as often as possible. There is one little point of practical value—the bed should not be too soft. A patient who suffers from paralysis agitans at an advanced stage, has great difficulty in turning over in bed when the position is not quite comfortable, and this difficulty, which is probably the most important cause of the sleeplessness, is increased if the bed be too soft. If there is difficulty in getting to sleep, on going to bed sulphonal or trional may be given two hours before retiring. If the sleeplessness is in the early morning, the sulphonal may be taken *immediately* before going to bed. A dose of hyoscine is of service in diminishing the tremor, and restlessness, and so promoting sleep. Hence as already mentioned hyoscine is sometimes best given twice a day, in the morning and just before going to bed. When the patient is much troubled with sleeplessness in the early morning, a dose of hyoscine taken at this time will often be of service by diminishing the restlessness, subjective symptoms, and tremor, and so causing the patient to fall asleep again. The exact dose of hyoscine required must be determined by commencing with a small amount and cautiously increasing. I have often given $\frac{1}{75}$ or $\frac{1}{61}$ of a grain by mouth, in such cases, with much advantage. Of course, if there is the possibility of a dose being required during the night, it is best to have the exact quantity of the medicine poured into a glass before going to bed and placed by the bed side—to be taken in the night if required.

The bed clothing should not be too warm and heavy.

For the troublesome pains in the limbs, antipyrin or phenacetin are sometimes of service.

Though we are unable to do anything to cure or even to arrest the disease, still by the palliative measures described—especially by life in the open air as much as possible, and by the administration of hyoscine—the patient's condition may be rendered much more comfortable.

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OTHER FORMS OF TREMOR AND THEIR CLINICAL FEATURES.

THE clinical characters of the various forms of tremor are of importance in diagnosis and consequently in prognosis ; and in several varieties the recognition of the cause of the tremor leads to successful treatment.

It is not proposed to discuss here the pathology of tremor, nor to consider its graphic representations which have been already carefully studied by Eshner,[1] but with somewhat negative results. The clinical peculiarities of the common forms of tremor will be pointed out ; also a number of rare varieties will be described ; and the character of the handwriting in the most important forms will be indicated.

Tremor is a symptom in many diseases ; in a number of affections it is the most prominent symptom and the one for which medical advice is sought.

In a clinical investigation of tremor it is important to note : (1) The parts affected. (2) Whether the tremor persists when the limb is supported (when the limb is at rest). (3) Whether the tremor is caused, increased, diminished, or arrested by voluntary movements. (4) The condition during the performance of certain delicate movements, such as bringing a glass of water to the mouth. (5) The rate and regularity of the movements. (6) The influence of mental emotions, excitement, &c. ; of attention, and of the will. (7) Whether the tremor affects the head. (8) The presence of other nervous symptoms ; the history of the case ; indications or history of alcoholism, plumbism, or other forms of poisoning.

As regards diagnosis and prognosis, it is important to determine, in the first place, whether the tremor is due to disseminated sclerosis or paralysis agitans ; then the other common causes of tremor should be considered ; but sometimes all these can be excluded and the chief or only symptom of the case is tremor for which no cause can be discovered.

Tremor in Paralysis Agitans.

This form of tremor has already been described, see page 8.

Tremor in Disseminated Sclerosis.

The tremor of disseminated sclerosis occurs only on voluntary movement. During repose there is no tremor; but on attempting to carry out any movement, such as touching the tip of the nose with the index finger, or on attempting to grasp any object, tremor occurs. Hence it is spoken of as intention tremor, or volitional tremor. In attempting to carry out one of the movements mentioned the arm jerks about in an irregular manner, first in one direction, then in another, until, with great effort, the object aimed at is reached. The tremor becomes quicker towards the end of the voluntary act. It consists of irregular oscillations or jerky movements of a coarse form, occurring at the rate of about five or six per second. But owing to the wide range of the movements the tremor appears more rapid. The tremor is clearly brought out by the well-known method of asking the patient to drink from a glass full of water. He seizes the glass, moves it towards his lips, but in doing so the hand begins to shake; the tremor increases as the mouth is approached, and the contents of the glass are spilled, and often the glass is knocked against the teeth. As Marie points out, the tremor is not limited to the extremity of the limb, nor to the muscles of the forearm; it affects the muscles about the scapula markedly. The tremor is increased by mental excitement, attention and effort, and by the patient's endeavour to check it. In mild cases tremor is only observed at the end of a voluntary movement; in severe cases it begins directly the action is commenced, and increases as the movement continues. Often it spreads to muscles not called into play in the movement. It occurs most frequently and is usually most marked in the arms; but the muscles of the head and neck and of the legs may also be affected. Sometimes the tremor is much more marked in the head and neck than in the arms. When the patient is sitting up in bed or on a chair, marked tremor of the head may be observed, even though he is not attempting to perform any movement of the head. This appears, as if the tremor of the head differed from that of the arm in occurring apart from voluntary movement. But observation will clearly show that when the head trembles, though the patient is not attempting to carry out any movement, still the muscles of the head and neck are in action in balancing or fixing the position of the head ; and hence the tremor is one associated with contraction of these muscles. That this explanation is true is shown by the fact that the tremor is arrested when the head is allowed to rest on the pillow, so that the contraction of all muscles connected with it cease.

The tremor of the arm interferes of course with all free movement of the limb. A female patient finds it difficult or impossible to thread a needle.

The handwriting is affected *early* and markedly. In severe forms, on attempting to use a pen, it is jerked so violently on the paper that only a few dashes are produced, and the pen is almost broken.

Fig. 3, Plate I., represents the result of the patient's attempt to write her name, in a severe form of the disease.

When the tremor is less severe the patient may be able to write ; but the writing is jerky, the letters are very irregular, and this jerky irregularity is often best seen at the end of a word or sentence. There is a marked coarse irregularity in the general form of the letters, whilst the separate strokes produced by the pen often present no irregularities in short portions. The movement of the pen is jerky, and often rapid towards the end of a word. (See Fig. 4, Plate I.).

The handwriting may be markedly affected when the tremor of the arm is very slight (as shown in Fig. 5, Plate I.) When the tremor of the hand is very slight the patient may be able to draw a very short line on paper fairly well ; but if the tremor is well marked, the line shows very coarse irregularities. (See Figs. 3 and 4, Plate II.).

Mercurial Tremor.

This form of tremor is very rarely met with. It may occur in workmen, who suffer from chronic mercurial poisoning, through employment in quicksilver mines, or in various trades (the making of mirrors, &c.) in which mercury is constantly used.

It begins in the face and tongue, and then affects the arms and afterwards the legs.

At first the tremor only occurs during excitement and it resembles that of disseminated sclerosis by occurring only on voluntary movement; but the tremor is said to be less wide and irregular. Though the tremor ceases for the most part during rest, still according to Charcot, from time to time slight tremor occurs even during repose. But the tremor is markedly increased by movement. At a late stage it becomes constant like the tremor of paralysis agitans.

Mercurial tremor is not associated with nystagmus and other symptoms common in disseminated sclerosis, nor with the peculiarities of gait and attitude which are characteristic of paralysis agitans.

Alcoholic Tremor.

Tremor is one of the most common symptoms, both in acute and chronic alcoholism. It occurs not only in the hands, but also in the lips, face, and tongue, and sometimes in the legs. In the hand the tremor is best seen on voluntary movement. In the mildest forms, when the limb is at rest, it may cease; but, if severe, it often continues, though it is much less than on voluntary movement. In the tremor the whole hand moves together with the forearm; the movement is not localised to the fingers, nor to flexion and extension of the wrist, as in paralysis agitans. When the hands are held out straight in front of the trunk the tremor continues, and it often consists chiefly of a lateral movement of the hand and forearm. After the patient has performed any voluntary movement, and the arm rests on some adjacent object, the tremor diminishes. When the patient attempts to draw a straight line it presents marked wavy irregularities. In the handwriting the letters are badly formed, and the separate lines are irregular and wavy: the form of the letter is, however, not so markedly irregular and jerky, as in disseminated sclerosis; the wavy irregularities of the lines are coarser and greater than in paralysis agitans. (See Figs. 6 and 7, Plate I.; and Fig. 5, Plate II.).

The history of the case and the nature of the tremor, its presence in the face, lips, and tongue, and the signs of alcoholism are generally sufficient to indicate the diagnosis: the other symptoms of disseminated sclerosis and paralysis agitans are absent, though sometimes there is slight nystagmus.

Tremor in lead poisoning.

Tremor in lead poisoning is a rare symptom; it is fine and occasionally resembles that of paralysis agitans; but it is usually increased by movement.

Other well-known signs of lead poisoning enable a correct diagnosis to be made.

Tremor is occasionally noted in a few other forms of chronic poisoning, but the diagnosis is usually easily made from the presence of characteristic symptoms.

Hysterical Tremor.

In hysteria, almost all forms of tremor can be roughly simulated. A fine tremor has been described which is especially marked on voluntary movements; also a coarse form is met with in which there are rhythmical movements of the hand or head apart from voluntary effort. Krafft-Ebing[3] has called attention to cases of hysterical tremor which simulate paralysis agitans. I have met with hysterical tremor of this kind, which at first sight was very suggestive of the tremor of paralysis agitans.

Hysterical tremor presents variations in intensity from time to time. Often it is not constant. It is increased during voluntary movement. It is markedly increased by excitement and emotional changes. It is increased when the attention is directed to it, whilst it may cease when the mind is diverted. The character of the tremor is apt to vary from time to time. It often appears first just after some mental shock or excitement.

Most forms of hysterical tremor can be distinguished from that of disseminated sclerosis by continuing when the arm is supported. In those cases in which the tremor occurs only on voluntary movement, other symptoms of the two diseases must be considered. The presence of nystagmus or optic atrophy would be in favour of disseminated sclerosis. From paralysis agitans* the tremor is usually easily diagnosed by being very greatly increased in intensity by voluntary movements of the arm, whilst in paralysis agitans usually the tremor ceases or is diminished on voluntary movements. Hysterical tremor often varies in intensity, in character and locality, whilst in paralysis agitans the nature of the tremor and the parts affected remain the same for long periods. In paralysis agitans the symptoms usually begin in one arm, and then affect the leg on the same side, so that for a time there is a hemiplegic distribution, whilst hysterical tremor often passes from one arm to the other, before the legs are affected. Tremor of the head is rare, especially as an early symptom, in paralysis agitans. The attitude of the body, the rigidity of the limbs, the position of the hands, so characteristic of paralysis agitans, are absent in hysterical tremor. I have seen tremor in hysteria produced chiefly by the action of the shoulder and upper arm muscles: in paralysis agitans these are the muscles least affected. Hysterical tremor occurs usually in young persons under the age of 40, *i.e.*, at a period of life when paralysis agitans is extremely rare. Of course before giving a diagnosis of hysterical tremor, signs of chronic poisoning by alcohol, mercury, and lead should be sought for, and the patient should be examined for evidences of organic disease of the nervous system, and for indications of hysteria.

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* Some of the diagnostic signs enumerated are those specially emphasised by Krafft-Ebing.

The handwriting of a case of hysterical tremor, which I obtained a few years ago showed great variability in the irregularities. The first word was tremulous and irregular, the second fairly regular. On attempting to draw a straight line, the result was a peculiar series of similar, fairly regular, wavy strokes closely resembling the wavy line which is so often and so easily produced voluntarily in underlining heading words in manuscript. (See Fig. 6, Plate II.).

Senile Tremor.

In old age tremor is often observed which bears some resemblance to that of paralysis agitans, but the attitude of the body, rigidity of the limbs, and position of the hands which characterise this disease are absent. Also the tremor differs from that of paralysis agitans. At the early stage senile tremor is noted only on movement and ceases during rest. When more advanced it occurs when the limbs are at rest, but is increased by movement; also the head is affected early. Both arms are affected and usually the onset of the tremor occurs about the same time in each. There is no progressive tendency in senile tremor. The age at onset is usually præsenile in paralysis agitans 40—60; in senile tremor it is usually later. Senile tremor is fine and there is no great incoordination of the voluntary movements. When the hand is observed carefully it will be seen that it moves together with the forearm, and that there is not the flexion and extension of the fingers (pill-rolling movements), nor the extension and flexion of the wrist; whilst one or both of these movements occur in paralysis agitans.

Fig. 8, Plate I., represents the handwriting in a case of senile tremor (patient aged 78). Though the general form of the letters is fairly good, the separate strokes show coarse wavy irregularities. When the patient attempts to draw a straight line the line presents coarse irregularities. (See Fig. 8, Plate II.).

Asthenic Tremor.

In the general weakness following many acute ailments, tremor is sometimes noted. It is a fine tremor and is made very marked by voluntary movement. In several cases of this form which have come under my own observation I have noted, that when the hand has been firmly supported by being placed flat on a table the tremor ceases; but if the hand be only partially supported—if it be placed in a position in which some slight muscular effort is necessary to maintain the posture, the tremor does not entirely cease. When the hands are held out in front of the trunk, or when any object is grasped the tremor is marked In some cases slight tremor of the lips is present. The whole hand and forearm move together in the tremor and there is not the specially flexion and extension of the fingers or wrist which characterise paralysis agitans. Nystagmus, scanning speech, and other symptoms of disseminated sclerosis, and the attitude and other symptoms of paralysis agitans are absent. There is generally muscular weakness and debility following some serious ailment, or, there is evidence of the presence of some disease causing great general weakness. I have seen this form of tremor associated with phthisis. The handwriting is greatly affected, the general shape of the letters is faulty and the separate lines present great wavy irregularities. (Fig. 9, Plate I.)

Tremor in Graves' Disease.

Tremor is frequently present in Graves' disease. Usually the movements are fine, constant, and rapid (8—10 oscillations per second). The separate movements have about the same amplitude The tremor is most marked in the hands and arms, but in severe cases other parts are also affected. It is seen well when the hands are held out straight in front of the body. The tremor is not dependent on voluntary *movements.* When the arms are placed flat on a table and completely supported, the tremor ceases or very greatly diminishes, but when the hands are held out unsupported in front of the chest, the tremor is well marked, even though no movement is being made. The tremor is present during repose if the muscles are not entirely thrown out of action.

The tremor is much affected by the mental state. Excitement, mental agitation or "nervousness" increase the tremor markedly; whilst mental repose diminishes it very much. It is markedly increased on attempting any delicate movement, such as writing. This is just the opposite of the usual condition in paralysis agitans. (The tremor in paralysis agitans, as already mentioned, usually diminishes or ceases when any delicate movement is attempted.) The tremor affects the hands *as a whole*, and the hand and forearm move together in the tremor. There are not the separate movements of the fingers—the pill-rolling movements—which are so characteristic of paralysis agitans. The muscles of head and neck, lips, face, and tongue are not affected. This feature separates the tremor of Graves' disease from that of general paralysis, of alcoholism, and from senile and asthenic tremor.

The handwriting is often greatly affected; the letters present marked coarse wavy irregularities of the lines. (Fig. 10, Plate I.).

On attempting to draw a straight line, the line presents fine irregularities. (Fig. 7, Plate II.).

Tremor in General Paralysis of the Insane.

Tremor is a frequent symptom, and affects especially the lips and tongue. In these parts it is seen when the patient speaks, shows the teeth, or protrudes the tongue. Tremor in the limbs is sometimes only slight, in other cases marked. The tremor of the arms is inconstant, and the movements unequal. The tremor occurs especially on voluntary movement, but continues also during repose. The writing is shaky and tremulous, the seperate strokes show marked wavy irregularities, and the letters are badly shaped. (Fig. 11, Plate I.). Words are often incomplete, syllables are omitted, and letters are not attached to one another. (Savage).

Tremor associated with gross lesions of the brain.

Occasionally after an attack of hemiplegia a fine tremor developes. It occurs mostly during movement, and is only observed in the arms.

In a case of tumour of the optic thalamus, which I saw with Dr. Edwards, of Chorlton-cum-Hardy, there was tremor in the right arm on voluntary movement, resembling that of disseminated sclerosis. The other symptoms pointed to a cerebral tumour, and the autopsy revealed a large tubercular mass in the optic thalamus.*

In tumours of the crus and pons not infrequently there is "a coarse, jerky inco-ordination, precisely resembling that which is seen in disseminated sclerosis." (Sir Wm. Gowers).

In lesions of the corpora quadrigemina tremor was present in the arms, on voluntary movement, like that of disseminated sclerosis, in 10 out of 17 cases analysed by Ferrier.

In birth palsy, occasionally a form of tremor occurs on voluntary movement, like that of disseminated sclerosis, to which the name of chorea spastica has been given.

Tremor is occasionally met with in cerebellar tumour; sometimes it has been an intention tremor like that of disseminated sclerosis; but it has apparently varied somewhat in character.

I have recorded a case of ataxia, of sudden onset, with tremor in the right arm which was present during rest but which was increased by voluntary movement. Nystagmus and paralysis of the right internal rectus, and afterwards a mild form of diabetes mellitus also developed. (*Lancet*, July 2nd, 1892).

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*The case has been recorded by Dr. Edwards. Thesis, Victoria University, "Disseminated sclerosis."—1895.

Hereditary Tremor.

A number of cases are on record in medical literature in which hereditary tremor has been observed. Recently Graupner has recorded the history of a family affected with tremor of this form. Two brothers and a sister, and a daughter of one of the brothers were all affected with a similar tremor. The tremor was chiefly in the arms though it affected other parts also: its rhythm was 3½—4½ per second, and it had the character of intention tremor.

From these cases, and from others published in medical literature, Graupner concludes that there is a disease occurring in families, of which the only symptom is tremor. The tremor may affect various voluntary muscles, and occasionally all the muscles, but it is most frequently met with in the arms, less frequently in the legs, the trunk, neck, lower jaw, and tongue. The type of the tremor is different in different families. In some cases it is an irregular coarse intention tremor, not very frequent, of almost convulsive character, and eventually complicated by convulsive contractions in single groups of muscles. In other cases it is a fine rhythmical oscillating tremor, which can be checked by voluntary effort.

Tremor dating from early Childhood.

Cases are occasionally met with in which tremor has been present since early infancy. Thus, in a boy aged 13, who was recently under the writer's care, there was a fine tremor of the hands which was stated to have been present since birth. The tremor occurred on voluntary movement, but ceased when the arm was supported. There were no symptoms of disseminated sclerosis and the tremor was much finer and less jerky than in that disease. In fact it resembled the fine tremor seen in Graves' disease. In the writing the general form of the letters was good, but the separate lines presented wavy irregularities.

In another similar case, that of a man aged 30, tremor had been present since the age of three and had followed some affection at that period which had caused unconsciousness.

The following are notes of a similar case in which the tremor was unilateral :—

Horace H., aged 50, had suffered more or less from tremor in the right hand since "a paralytic attack" in early childhood. The "paralytic" symptoms had disappeared but tremor in the hand had remained. At school he learned to write, but he always had more difficulty in writing than other children. At the age of 16 he commenced to work as a printer, but about the age of 20 the tremor increased so much that he obtained employment as a farm labourer: this he continued for six years, but since that time he has done very little work.

There is constant fine tremor in the right arm, the separate movements are of the same amplitude and nature; occasionally tremor occurs in the right leg (during excitement). During repose the tremor continues in the right arm, but it is worse on voluntary movement. The tremor is produced chiefly by the muscles about the elbow and shoulder; there is little separate movement of the fingers and wrist, and the whole hand is moved together with the forearm. By raising the arm vertically above the head or by placing the right hand on the side the tremor is arrested. The writing is very irregular in the shape of the letters and in the separate strokes. When the patient attempts to draw a straight line it presents great irregularities. There are no indications of disseminated sclerosis or paralysis agitans. There is slight rigidity of the right leg and the patient drags the right foot and scrapes the toes in walking. The knee jerks are both increased but there is no ankleclonus. There is no paralysis of the face and the movements of the arm are good. There is no anæsthesia.

The following are the notes of a curious case of tremor and rotatory nystagmus dating from early infancy:—

H. K., female, aged 20, complains of tremor of the hands. This symptom has been present since infancy. The patient's mother cannot say exactly when it was first noticed, whether soon after birth or a few weeks later, but it has certainly been present since the age of three months. The patient was unable to walk until the age of six years. Since the age of 10 years there has been some unsteadiness in walking.

There is now marked tremor of the hands somewhat resembling that seen in Graves' disease but coarser. The whole hand and forearm move together in the constant tremulous movements, and there is not the special movement at the wrist and fingers as in paralysis agitans. When the hand is very firmly supported, by placing it flat on the table the tremor sometimes ceases, but when the hand and forearm are only slightly supported the tremor is marked. When the hands are held out straight in front of the chest the tremor is marked. It is not increased by voluntary movements. There is also a constant rapid nystagmus or oscillation of the eyeballs, the movements being chiefly lateral with a slight rotation of the eyeballs. Even when the patient is not directing her attention specially to any object there is a persistent rapid movement of the eyeballs. The voice is tremulous, and there is very slight tremor of the head and neck. The patient walks with the feet widely separated and is rather unsteady. Mentally she is very dull. There is no actual paralysis of limbs or cranial nerves, the knee jerks are present and there is no ankle-clonus. I saw the case frequently during a period of three years but the symptoms remained stationary.

Simple or Essential Tremor.

In addition to the varieties of tremor already mentioned, there remains another ill-defined group of cases, for which, at present, no cause can be made out. Tremor is the only symptom, or the only important symptom ; it persists for years, and apart from the inconvenience which it causes, there is no other complaint. These cases do not develop into paralysis agitans or disseminated sclerosis, and this is a point of importance in the prognosis.

The tremor may be fine or coarse. It is often increased by movement and mental emotions : during repose, in some cases, it diminishes or ceases, but in other cases it continues. The hands are the parts most affected.

Sometimes it is first excited by emotional causes ; in other cases the causation is quite obscure. The other signs of paralysis agitans or disseminated sclerosis are of course absent.

The following is an abstract of notes of a case of tremor occurring in a "striker" employed at a blacksmith's shop :

John G., aged 74, had been engaged for 37 years in a large blacksmith's shop. In his work, which was very heavy, he was chiefly occupied in knocking in iron rivets. About eight years before he consulted me he had first noticed the tremor, which commenced in the right hand. At the end of two years, owing to the gradual increase in the tremor, he was unable to continue his work. Thus for six years he has been unable to do any work on account of the tremor, and for five years he has been unable to feed himself with the right hand. The tremor in the left hand has been less troublesome. The legs and face have not been affected.

The tremor continues when the hand and arm are well supported. On voluntary movement there is little change ; it is not increased, as in disseminated sclerosis, neither is it arrested or diminished, as in many cases of paralysis agitans. The tremor is coarse, and is produced chiefly by movements at the wrist rather than in the fingers and thumb. He is unable to hold any object, such as a piece of paper or pen, steadily. He has never been able to write, but when he attempts to draw a straight line the line presents numerous coarse irregularities. (In this respect also the case differs from paralysis agitans). There is no nystagmus, no affection of speech, or other symptom of disseminated sclerosis. Also there is no muscular rigidity or peculiar attitude of the body, such as is seen in paralysis agitans. The age of the patient at the onset of the affection was more advanced than in paralysis agitans. The patient thinks that the tremor has been produced by his work, and it is not improbable that it may have played some part in the causation.

In the following case the cause of the tremor was very obscure :

William W., aged 70. The tremor had commenced gradually, about seven years ago. Both arms were affected, the right more than the left. The face was not affected. The tremor was more coarse than that of paralysis agitans ; and the whole of the limb was affected violently. In the right arm the tremor continued when the limb was supported ; it was increased by voluntary movement. In the left arm there was tremor on voluntary movement, but this was less than on the right side, and the tremor ceased when the arm was at rest. There were no indications of paralysis agitans or disseminated sclerosis. The patient stated that an uncle suffered from a similar tremor in the hands. Otherwise no indication of the cause of the tremor could be made out.

Tremor in Myokymia.

An exceedingly rare disease may be here mentioned amongst the causes of tremor. This is a condition in which there is a persistent and diffused quivering of the muscles. Sometimes only a small bundle of muscle fibres contracts (as in the fibrillary contractions seen in amyotrophic lateral sclerosis, progressive muscular atrophy, &c.). At other times several bundles of fibres or the whole of the muscle is thrown into contraction. These contractions of muscle substance occur very rapidly and irregularly, and are persistent. To this condition the name of myokymie has been given by Schultze. The muscular contractions are naturally the cause of a certain amount of unsteadiness or slight shaking in the limbs affected, both during voluntary movement and repose.

In a case of this disease, which I have recorded elsewhere,* all the limbs were affected, as well as the muscles of the face, tongue, head, and neck, and the trunk muscles slightly. All of the limb muscles were affected with the muscle quivering, and there was not the special localisation of the tremulous movement to the fingers or wrist as in paralysis agitans. The quivering, and consequently the slight tremor of the limbs affected, continued during repose. The tremor was not much influenced by movement: if changed at all, it was perhaps slightly, but only slightly, increased by movement of the limb. In this case the muscular quivering had been present for two years.

GENERAL REMARKS.

The number of vibrations per second varies somewhat in the different forms of tremor. The following are the numbers given by various authors :—

Paralysis agitans 3—7 per second (Charcot 3—6 ; Gowers

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* *Brit., Med. Journal*, 1900, December 15th.

4·8—7; Marie 4—5; Peterson 3·7—5·6; Wollenberg, usually 4—5).

Senile tremor 4—5½ per second (Dana).

Hysteria major 5½—7½ per second (Dana).

Disseminated sclerosis, 6—7 (Marie); early stages, 7·9—8·1 per second (Peterson); later stages, 4·6—6·3 per second (Peterson).

Graves' disease and alcoholic tremor, 8—9 (Charcot).

Congenital tremor, 8—9 per second (Dana).

Neurasthenia, 10 per second (Dana).

Levy-Dorn[6] has shown, that when the number of vibrations per second is comparatively low, the number of voluntary movements which the patient can make per second, with the index finger, is correspondingly low, and *vice versa*.

In cases of paralysis agitans and disseminated sclerosis in which tremor has been absent, there has been a diminution in the number of movements which can be made by the index finger. In health the number of movements which the index fingers can make by pressing on a Morse electrical key is 9 per second. The following table gives the number of vibrations per second of the tremulous hand, and the number of movements which can be made per second by the finger of the same patient in several diseases. (Levy-Dorn).

	Rate of Tremor.	No. of Voluntary Movements of Index Finger.
Paralysis Agitans ..	7 per second ...	7 per second
	5 or 6 ,, ...	6 ,,
	5 ,, ...	5 ,,
Disseminated Sclerosis	6 ,, ...	6 ,,
	5 ,, ...	5 ,
Graves' Disease	10 ,, ...	9 ,,
	6 ,, ...	7 ,,
Neurasthenia	9 ,, ...	9 ,,
	11 ,, ...	10 ,,

Forms of Tremor.

The relation of tremor to voluntary movement enables us to arrange the cases into three groups; but there are other sub-varieties.

(1) Tremor occurring during repose of the limb, but ceasing or diminishing on voluntary movement with attention—tremor which ceases when an object is grasped or when the hands are held out. The tremor in paralysis agitans is usually of this form.

(2) Tremor occurring only on voluntary movement and ceasing during repose (intention tremor). This is the form of tremor in disseminated sclerosis, even at an advanced stage; but several other forms of tremor, at a *very early stage*, only occur on voluntary movement.

(3) Tremor which occurs during repose, but which is much greater during voluntary movement; as in most cases of marked alcoholic, senile, asthenic, simple and hysterical tremor, and in several other varieties.

Affection of the Handwriting in Tremor.

The character of the handwriting in various forms of tremor is interesting. Broadly, three groups of cases may be recognised, according to the writing.

(1) In disseminated sclerosis the handwriting is greatly affected. If the tremor be well marked, writing is often quite impossible. At an early stage of the disease, even when the tremor is only very slight, the writing is affected markedly. It is jerky especially at the end of a word or sentence. The letters show coarse jerky irregularities and are badly shaped. But the separate lines do not usually show fine wavy irregularities; for short distances they are fairly steady and without tremor, then there is a sudden jerky irregularity.

(2) In paralysis agitans the opposite condition is met with. The tremor is often very advanced before there is much affection of the handwriting. The patient is obliged to write more and more slowly, but it is often surprising how well he can write, with care, even when the tremor is advanced. The general form of the letters is good and the general character of the writing regular; but the separate strokes show fine wavy irregularities. At first these are only seen by a lens; later they are evident to the naked eye, but are small and fine. The wavy fine indentations in the strokes often occur at fairly regular intervals. This is the character

the writing in many cases of paralysis agitans, even when the tremor and other symptoms are very marked. But sometimes the writing is more irregular especially at a very advanced stage of the disease.

(3) In most of the other forms of tremor the writing is markedly affected, except when the tremor is very slight. The form of the letters is more irregular than in paralysis agitans, but not so coarsely irregular as in disseminated sclerosis. The separate strokes show coarse wavy irregularities, much coarser than those of paralysis agitans. This is the character of the handwriting in senile alcoholic and neurasthenic tremor, and also in the tremor of Graves' disease.

The patient's attempt to draw a straight line on paper is interesting.

(*a*) In disseminated sclerosis the line drawn does not present fine undulations, but it is coarsely irregular and jerky, and the general direction is very bad when the tremor is marked.

It may be fairly straight for a short distance when the tremor is very slight.

(*b*) In paralysis agitans the line is fairly straight. Even when the tremor is marked it may show no evidence, or little evidence, of wavy irregularities, and the general direction is good.

(*c*) In most other forms of tremor the line drawn by the patient usually shows, very markedly, fine or coarse wavy irregularities, even when the tremor is not advanced.

I am prepared to admit, that there are exceptions to these general conclusions with respect to the handwriting and the attempt to draw a straight line in the various forms of tremor, especially at advanced stages of the disease. But in most cases, I believe, the description just given will be found correct and of some diagnostic value. The difference is owing to the fact that usually the tremor diminishes in paralysis agitans when the patient attempts to perform any voluntary movement, whilst this is not the case in other forms of tremor. Hence the writing and the lines drawn by a patient suffering from paralysis agitans, present usually less irregularity than in other forms of tremor.

The *diagnosis* of the nature of the tremor is important, in some cases as regards the treatment, and in others as regards the prognosis. If on careful examination the tremor is evidently due to alcoholism, mercury, or lead poisoning, or if it is hysterical in nature, then suitable treatment may be followed by recovery.

As regards prognosis it is most important to determine whether the tremor is due to the two most important causes—paralysis agitans or disseminated sclerosis.

In the diagnosis of these two diseases the detection of the other symptoms, besides tremor, is of the greatest importance. If these be absent, then the general history of the case and the character of the tremor may be diagnostic. A tremor which commences in one hand between the ages of 40 and 60, which produces the pill-rolling movements of the fingers, or marked extension and flexion movements at the wrist, which continues during repose of the limb, and which is arrested during careful voluntary movements, is almost certainly due to paralysis agitans. The ability to draw a straight line (on paper) which shows no wavy or jerky irregularities, and the very slight affection of the handwriting, even when the tremor is well marked, are two points in favour of this diagnosis.

A marked tremor, which has commenced gradually between the ages of 15 and 40, which occurs only on voluntary movement, and ceases entirely on repose of the limb, is most frequently due to disseminated sclerosis; but if other indications of the disease are absent, all the cause of tremor already enumerated should be considered before giving a diagnosis, since some other forms of tremor have these characters especially at the onset.

Occasionally the tremor in paralysis agitans and disseminated sclerosis does not correspond to the common form: in such cases the diagnosis is difficult, and must be based on the appearance of other symptoms of these diseases.

In 50 cases in which I have notes of the characters of the tremor, either because it was such a well-marked symptom, or because it was the symptom for which the patient sought medical advice, the cause was as follows:—

	Cases.
Disseminated sclerosis	10
Paralysis agitans	11
Alcoholic tremor	4
Senile tremor	2
Tremor dating from birth or early infancy	4
Hysterical tremor	2
Asthenic tremor	2
Tremor associated with disease of the optic thalamus	2
Unilateral tremor with ataxia (cause ?)	2
Graves' disease	6
General paralysis of the insane	2
Simple tremor	2
Myokymia	1

This table does not, of course, acurately represent the frequency of the various forms of tremor, but it furnishes some indication of the chief varieties met with in medical practice.

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Plate 1.

HANDWRITING IN VARIOUS FORMS OF TREMOR.

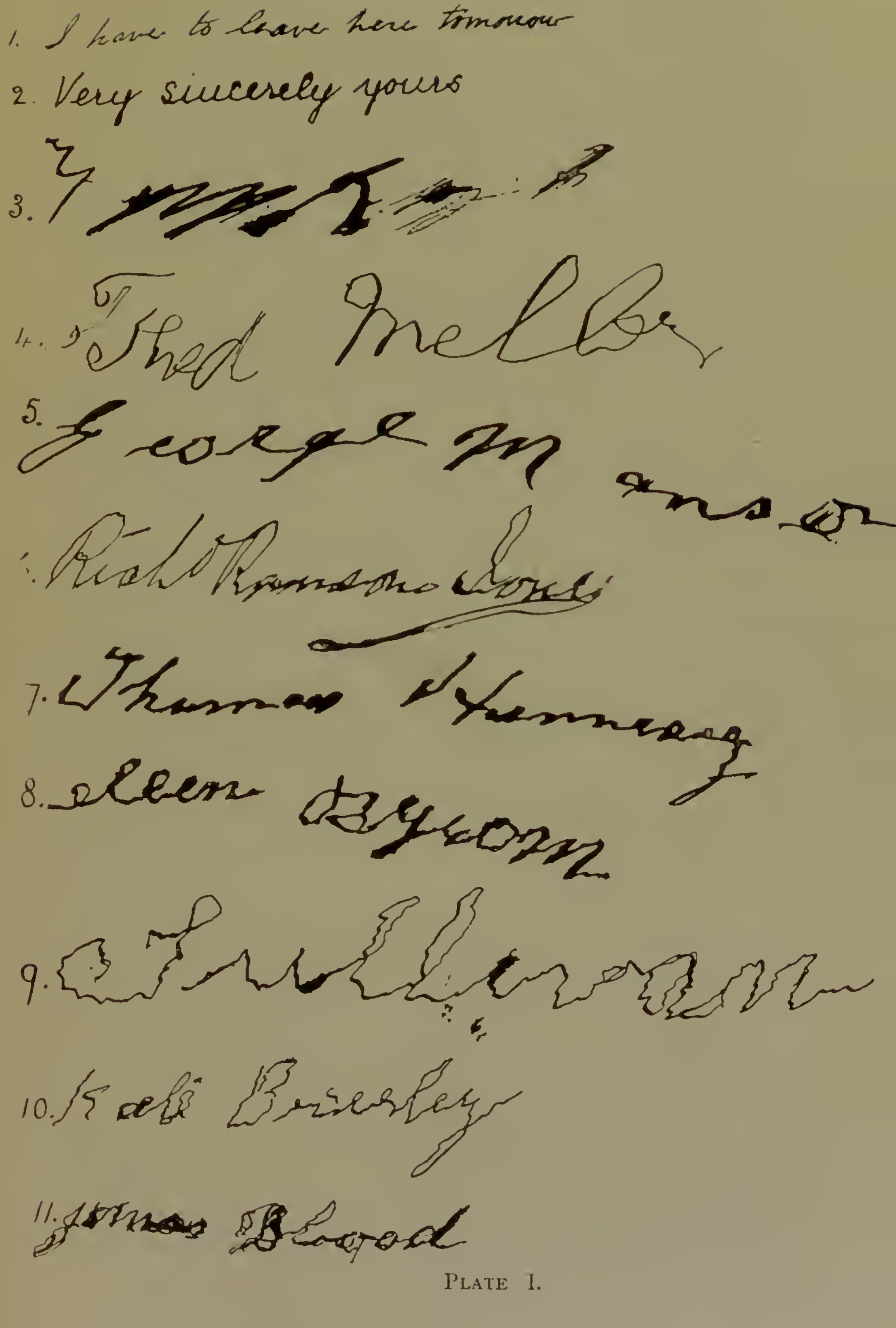
1 and 2. Paralysis Agitans (advanced).
3 and 4. Disseminated Sclerosis (advanced).
5. Disseminated Sclerosis (early).
6. Alcoholic Tremor.
7. Alcoholic Tremor.
8. Senile Tremor.
9. Asthenic Tremor.
10. Tremor in Graves' Disease.
11. Tremor in General Paralysis of the Insane.

Plate 2.

LINES DRAWN BY THE PATIENT IN VARIOUS FORMS OF TREMOR.

The lines marked W were drawn, under similar conditions, by the writer of this article, for comparison with those drawn by the patient, which are marked P.

1. Paralysis Agitans (advanced).
2. Paralysis Agitans (advanced).
3. Disseminated Sclerosis (early).
4. Disseminated Sclerosis (advanced).
5. Alcoholic Tremor.
6. Hysterical Tremor.
7. Tremor in Graves' Disease,
8. Senile Tremor.



1. I have to leave here tomorrow
2. Very sincerely yours
3.
4. Fred Meller
5. George Manson
6. Richd Ransome Jones
7. Thomas Stenney
8. Allen Byrom
9. J Sullivan
10. Kate Brierley
11. James Blood

PLATE I.

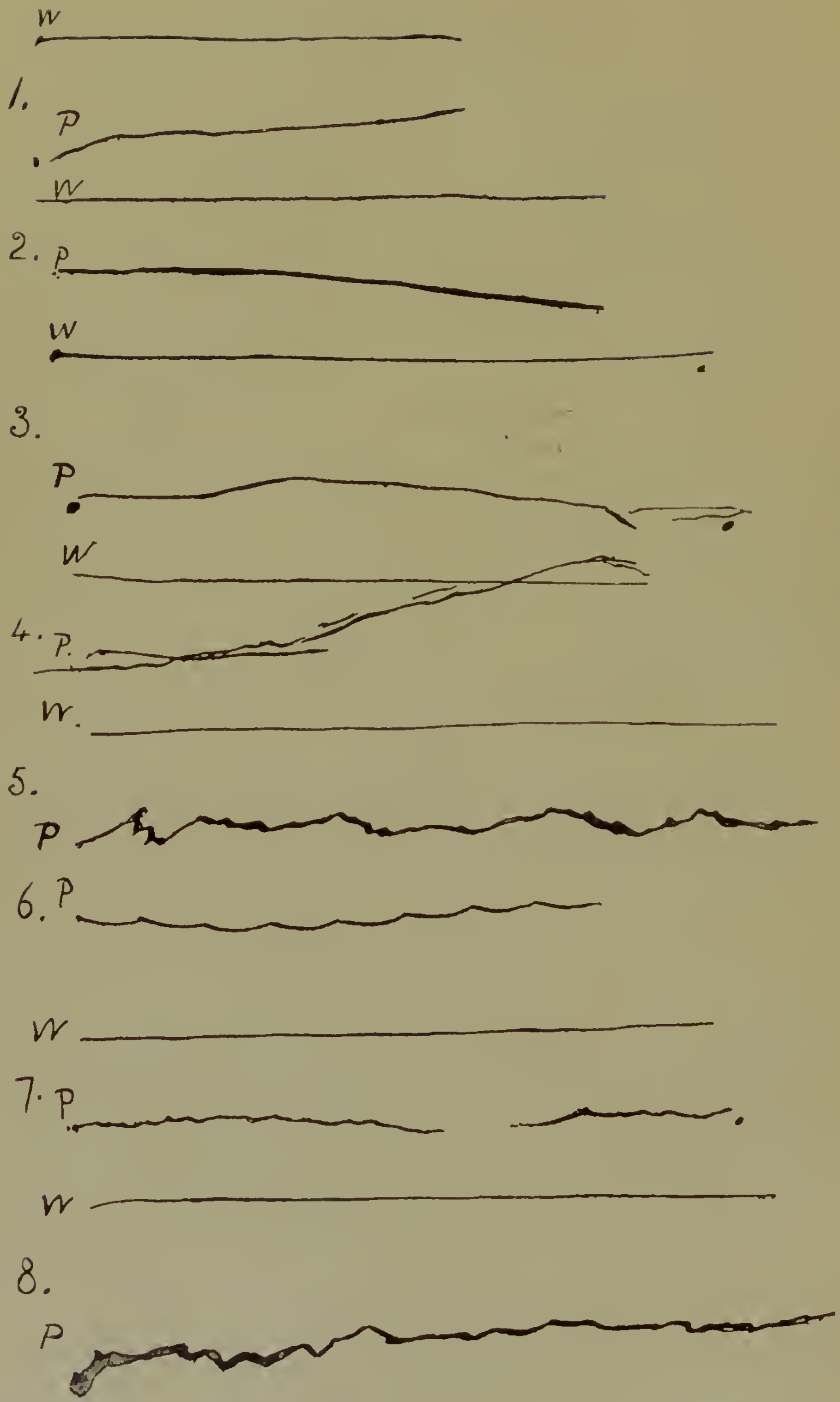


Plate II.